# STEEL CONSTRUCTION

AMERICAN INSTITUTE
OF
STEEL CONSTRUCTION
INC.

# STEEL CONSTRUCTION

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INC.

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# PREFACE

## FIRST EDITION

THIS volume combines the information contained in our previous publications. Considerable new material has been added, and the data regarding the new sections recently produced by the various rolling mills is complete up to the date of publication.

We are also including, a Specification for Fireproofing, which has been prepared for us by a committee of well known engineers. This Specification together with the data derived from tests of insulating material will make possible the designing of the fireproofing for a structural steel frame on a rational basis and supplant the empirical procedure of the past.

New paragraphs have been added to our Code of Standard Practice, and other slight revisions made, which our experience indicates to have been desirable.

The general arrangement of the tabular information regarding the Dimensions, Functions, and Allowable Load for Structural Steel Shapes is now well known. It has been most favorably commented upon, particularly on account of the ease with which the desired information can be found. With this in mind, we have endeavored to design and group all the additional tabular data.

The arrangement of tables to provide the maximum convenience required related data to appear on opposite pages thus causing a few single blank pages. For the convenience of the user these pages have been ruled with cross section lines for notes and diagrams.

A list of General Contents appears on Page 4, and there is a complete index at the back of the book.

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# Part I

## Standard Specifications

Specification of the American Institute of Steel Construction, Inc. for the Design, Fabrication and Erection of Structural Steel for Buildings; adopted June 1st, 1923, revised Nov. 1st, 1928.

Specification of the American Society for Testing Materials for Structural Steel for Buildings.

Code of Standard Practice of the American Institute of Steel Construction, Inc.; adopted Oct. 1st, 1924, revised 1927; 1928.

Specification of the American Institute of Steel Construction, Inc., for the Fireproofing of Structural Steel for Buildings; adopted Oct. 8th, 1927.

Recommendations of the United States Department of Commerce for the Minimum Allowable Live Loads for Buildings.

## The History of Steel and Iron

In 1923 the American Institute of Steel Construction undertook the work of promoting uniform practice in the industry, and in order that its efforts would not be interpreted as being unduly influenced by commercial interests it selected a committee from among the leading talent in the academic, engineering and architectural professions to prepare a Standard Specification on the Design, Fabrication, and Erection of Structural Steel. This committee represented a combined experience of approximately one hundred and fifty years in an industry which is not more than thirty-five years old. The personnel was as follows:

GEORGE F. SWAIN: M. Am Soc C E—M. Am Soc M E—M. Inst C E M. A R E A—Past President, A S C E—Professor of Civil Engineering, Harvard University

MILO S. KETCHUM: M. Am Soc C E—M. A R E A—Dean of the College of Engineering, and Director of the Engineering Experiment Station of the University of Illinois

E. R. GRAHAM: of Graham, Anderson, Probst & White, Architects, Chicago, Ill.

W. J. THOMAS: M. Am Soc C E—Chief Engineer, Geo. B. Post & Sons, Architects, N. Y.

WILBUR J. WATSON: M. Am Soc C E—M. A R E A—President, Watson Engineering Company, Cleveland, Ohio

# STANDARD SPECIFICATION

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION

Gentlemen:

After careful deliberation the Committee selected to prepare a Standard Specification for the design, fabrication and erection of structural steel for buildings, submit the accompanying Code for your adoption.

The present Specification contemplates that the inspection, is such that improper material containing defects which should cause rejection is not used. It is not intended to cover material salvaged from previous construction, which should not be used except under rigid supervision and inspection.

It is also understood that the proper loads are taken and that impact is allowed for in each case by adding a proper percentage to the stresses produced by static live loads so that the total stress found in any member is an equivalent static stress. This Specification does not attempt to state definitely what the live, dead, or wind loads should be, or what percentage should be added for impact, as these are factors which should receive the careful consideration of competent engineers for each case. The question of corrosion under unusual conditions should have careful consideration by the engineer.

The question of design is all-important. It necessarily presupposes that the design is good, made by and executed under the supervision of competent structural engineers; that proper provision is made for secondary stresses, excentric loads, unequal distribution of stresses on rivets, etc.; that the details are suitable and that the workmanship is high grade.

It is recommended that the American Institute of Steel Construction maintain a Committee whose function shall be that of keeping such a Code as we submit consistent with the changing conditions of manufacture, design, and erection. Under these conditions, the Committee considers the unit stresses herein specified are proper.

Respectfully submitted by the Committee:

GEORGE F. SWAIN
MILO S. KETCHUM
E. R. GRAHAM
W. J. THOMAS
WILBUR J. WATSON

June 1st 1923

# STANDARD SPECIFICATION FOR STRUCTURAL STEEL FOR BUILDINGS

**As adopted by the American Institute of Steel Construction**

**1.** This Specification defines the practice adopted by the American Institute of Steel Construction for the design, fabrication, and erection of structural steel for buildings.

## 2. GENERAL

To obtain a satisfactory structure, the following major requirements must be fulfilled.

(a) The material used must be suitable, of uniform quality, and without defects affecting the strength or service of the structure.

(b) Proper loads and conditions must be assumed in the design.

(c) The unit stresses must be suitable for the material used.

(d) The workmanship must be good, so that defects or injuries are not produced in the manufacture.

(e) The computations and design must be properly made so that the unit stresses specified shall not be exceeded, and the structure and its details shall possess the requisite strength and rigidity.

## 3. MATERIAL

Structural steel shall conform to the Standard Specifications of the American Society for Testing Materials for Structural Steel for Buildings, Serial Designation A 9-21, as amended to date.

## 4. LOADING

(a) Steel structures shall be designed to sustain the dead weight imposed upon them, including the weight of the steel frame itself, and, in addition, the maximum live load as specified in each particular case. Proper provision shall be made for temporary stresses caused by erection.

(b) In cases where live loads have the effect of producing impact or vibration, a proper percentage shall be added to the static live load stresses to provide for such influences, so that the total stress found in any member is an equivalent static stress.

(c) Proper provision shall be made for stresses caused by wind both during erection and after completion of the building. The wind pressure is dependent upon the conditions of exposure, but the allowable stresses specified in section five (5), paragraphs (f) and (g), are based upon the steel frame being designed to carry a wind pressure of not less than twenty (20) pounds

per square foot on the vertical projection of exposed surfaces during erection, and fifteen (15) pounds per square foot on the vertical projection of the finished structure.

(d) Proper provision shall be made to securely fasten the reaction points of all steel construction and transmit the stresses to the foundations of the structure.

## 5. ALLOWABLE STRESSES

All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per sq. in. shall not exceed the following:

**(a) *Tension.**

Rolled Steel, on net section ..... 18000

On the area of the nominal diameter of rivets under the limitations defined in Section 13, Paragraph **e** ..... 13500

**(b) Compression.**

Rolled Steel, on short lengths or where lateral deflection is prevented. 18000

On gross section of columns,

$$\frac{18000}{1 + \frac{l^2}{18000\,r^2}}$$

with a maximum of ..... 15000

in which $l$ is the unsupported length of the column, and $r$ is the corresponding least radius of gyration of the section, both in inches.

For main compression members, the ratio $l/r$ shall not exceed 120, and for bracing and other secondary members, 200.

**(c) Bending.**

On extreme fibres of rolled shapes, and built up sections, net section, if lateral deflection is prevented ..... 18000

When the unsupported length $l$ exceeds 15 times $b$, the width of the compression flange, the stress in pounds per sq. in. in the latter shall not exceed

$$\frac{20000}{1 + \frac{l^2}{2000\,b^2}}$$

The laterally unsupported length of beams and girders shall not exceed 40 times $b$ the width of the compression flange.

On extreme fibres of pins, when the forces are assumed as acting at the center of gravity of the pieces ..... 27000

**(d) Shearing.**

On pins ..... 13500

On power-driven rivets ..... 13500

On turned bolts in reamed holes with a clearance of not more than 1/50 of an inch ..... 13500

On hand-driven rivets ..... 10000

On unfinished bolts ..... 10000

*revised Nov. 1st, 1928.

On the gross area of the webs of beams and girders, where $h$, the height between flanges in inches, is not more than 60 times $t$, the thickness of the web in inches ..... 12000

On the gross area of the webs of beams and girders if the web is not stiffened where $h$, the height between flanges in inches, is more than 60 times $t$, the thickness of the web, the maximum shear per square inch, $\frac{V}{A}$ shall not exceed

$$\frac{18000}{1 + \frac{h^2}{7200\,t^2}}$$

In Which V is the total shear, and A is gross area of web in square inches.

**(e) Bearing.**

| | Double Shear | Single Shear |
|---|---|---|
| On pins | 30000 | 24000 |
| On power-driven rivets | 30000 | 24000 |
| On turned bolts in reamed holes | 30000 | 24000 |
| On hand-driven rivets | 20000 | 16000 |
| On unfinished bolts | 20000 | 16000 |

On expansion rollers per lineal inch 600 times the diameter of the roller in inches.

(f) **Combined Stresses.** For combined stresses due to wind and other loads, the permissible working stress may be increased 33⅓%, provided the section thus found is not less than that required by the dead and live loads alone.

(g) **Members Carrying Wind Only.**
For members carrying wind stresses only, the permissible working stresses may be increased 33⅓%.

## 6. SYMMETRICAL MEMBERS.

Sections shall preferably be symmetrical.

## 7. BEAMS AND GIRDERS.

(a) **Rolled beams** shall be proportioned by the moment of inertia of their net section. Plate girders with webs fully spliced for tension and compression shall be so proportioned that the unit stress on the net section does not exceed the stresses specified in section five (5) as determined by the moment of inertia of the net section.

(b) **Plate girder webs** shall have a thickness of not less than 1-160 of the unsupported distance between the flanges.

(c) **Web splices** shall consist of a plate on each side of the web capable of transmitting the full stress through the splice rivets.

(d) **Stiffeners.** Stiffeners shall be required on the webs of rolled beams and plate girders at the ends and at points of concentrated loads, and at other points where $h$ the clear distance between flanges is greater than $85t\sqrt{18000\ (A/V)-1}$, in which $t$ is the thickness of the web. When stiffeners are required, the distance in inches between them shall not be greater than $85t\sqrt{18000\ (A/V)-1}$, or not greater than 6 feet. When $h$ is greater than 60 times $t$ the thickness of the web of a plate girder, stiffeners shall be required at distances not greater than 6 feet apart. Stiffeners under or over concentrated loads shall be proportioned to distribute such loads into the web.

Plate girder stiffeners shall generally be in pairs, one on each side of the web, and shall have a close bearing against the flange angles at points of concentrated loading; stiffeners over the end bearings shall be on plate fillers. The pitch of rivet in stiffeners shall not exceed 6″.

(e) **Flange plates** of all girders shall be limited in width so as not to extend more than 6″ or more than 12 times the thickness of thinnest plate beyond the outer row of rivets connecting them to the angles.

(f) **Crane runway girders** and the supporting framework shall be proportioned to resist the greatest horizontal stresses caused by the operation of the cranes.

(g) **Rivets** connecting the flanges to the web at points of direct load on the flange between stiffeners shall be proportioned to carry the resultant of the longitudinal and tranverse shears.

(h) **Rivets** connecting the flanges to the webs of plate girders and of columns subjected to bending shall be so spaced as to carry the increment of the flange stress between the rivets.

## 8. COLUMN BASES.

(a) Proper provision shall be made to distribute the column loads on the footings and foundations.

(b) The top surface of all column bases shall be planed for the column bearing.

(c) Column bases shall be set true and level, with full bearing on the masonry, and be properly secured to the footings.

## 9. EXCENTRIC LOADING.

Full provision shall be made for stresses caused by excentric loads.

## 10. COMBINED STRESSES.

(a) Members subject to both direct and bending stresses shall be so proportioned that the greatest combined stresses shall not exceed the allowed limits.

(b) All members and their connections which are subject to stresses of both tension and compression due to the action of live loads shall be designed

to sustain stress giving the largest section, with 50% of the smaller stress added to it. If the reversal of stress is due to the action of wind, the member shall be designed for the stress giving the largest section and the connections proportioned for the largest stress.

**11. ABUTTING JOINTS.**

Compression members when faced for bearings shall be spliced sufficiently to hold the connecting members accurately in place. Other joints in riveted work, whether in tension or compression, shall be fully spliced.

**12. NET SECTIONS.**

(a) In calculating tension members, the net section shall be used, and in deducting the rivet holes they shall be taken ⅛ inch greater in diameter than the nominal diameter of the rivets.

(b) Pin-connected tension members shall have the section through the pinhole 25% in excess of the net section of the member, and a net section back of the pin hole equal to 75% of that required through the pin hole.

**13. RIVETS AND BOLTS.**

(a) In proportioning rivets, the nominal diameter of the rivet shall be used.

(b) Rivets carrying calculated stresses, and whose grip exceeds five diameters, shall have their number increased 1% for each additional 1/10 inch in the rivet grip. Special care shall be used in heating and driving such rivets.

(c) Rivets shall be used for the connections of main members carrying live loads which produce impact, and for connections subject to reversal of stresses.

(d) Finished bolts in reamed holes may be used in shop or field work where it is impracticable to obtain satisfactory power-driven rivets. The finished shank shall be long enough to provide full bearing, and washers used under the nuts to give full grip when turned tight.

Unfinished bolts may be used in shop or field work for connections in small structures used for shelters, and for secondary members of all structures such as purlins, girts, door and window framing, alignment bracing and secondary beams in floor.

*(e) The end reaction stresses of trusses, girders, or beams, and the axial stresses of tension or compression members which are carried on rivets, shall have such stresses developed by the shearing and bearing values of the rivets; but where rivets are used for shelf or bracket supports or for connections that also provide rigidity to the structure, the rivets may in addition to their shearing and bearing stresses, carry tension as defined in Sec. 5 (a).

**14. RIVET SPACING.**

(a) The minimum distance between centers of rivet holes shall be three diameters of the rivet; but the distance shall preferably be not less than 4½

*revised Nov. 1st, 1928.

inches for 1¼ inch rivets, 4 inches for 1⅛ inch rivets, 3½ inches for 1 inch rivets, 3 inches for ⅞ inch rivets, 2½ inches for ¾ inch rivets, 2 inches for ⅝ inch rivets, and 1¾ inches for ½ inch rivets. The maximum pitch in the line of stress of compression members composed of plates and shapes shall not exceed 16 times the thinnest outside plate or shape, nor 20 times the thinnest enclosed plate or shape with a maximum of 12 inches, and at right angles to the direction of stress the distance between lines of rivets shall not exceed 30 times the thinnest plate or shape. For angles in built sections with two gage lines, with rivets staggered, the maximum pitch in the line of stress in each gage line shall not exceed 24 times the thinnest plate with a maximum of 18 inches.

(b) In tension members composed of two angles, a pitch of 3′-6″ will be allowed, and in compression members, 2′-0″, but the ratio $l/r$ for each angle between rivets shall not be more than ¾ of that for the whole member.

(c) The pitch of rivets at the ends of built compression members shall not exceed four diameters of the rivets for a length equal to 1½ times the maximum width of the member.

(d) The minimum distance from the center of any rivet hole to a sheared edge shall be 2¼ inches for 1¼ inch rivets, 2 inches for 1⅛ inch rivets, 1¾ inches for 1 inch rivets, 1½ inches for ⅞ inch rivets, 1¼ inches for ¾ inch rivets, 1⅛ inches for ⅝ inch rivets, and 1 inch for ½ inch rivets. The maximum distance from any edge shall be 12 times the thickness of the plate, but shall not exceed 6 inches.

## 15. CONNECTIONS.

(a) Connections carrying calculated stresses except for lacing, sag bars, or angles, hand rails, or beam connections, shall not have less than 2 rivets; or for field connections not less than 3 rivets.

(b) Members meeting at a joint shall have their lines of center of gravity meet at a point if practicable; if not, provision shall be made for any eccentricity.

(c) The rivets at the ends of any member transmitting the stresses into that member should have their centers of gravity in the line of the center of gravity of the member; if not, provision shall be made for the effect of the resulting excentricity. Pins may be so placed as to counteract the effect of bending due to dead load.

(d) When a beam or girder "A" is connected to another member in such a manner that "A" acts as a continuous or fixed end beam, proper provision shall be made for the bending moments at such a connection.

(e) Where stress is transmitted from one piece to another, through a loose filler, the number of rivets shall be properly increased; tight-fitting fillers shall be preferred.

## 16. LATTICE.

(a) The open sides of compression members shall be provided with lattice having tie plates at each end and at intermediate points if the lattice is

interrupted. Tie plates shall be as near the ends as practicable. In main members carrying calculated stresses the end tie plates shall have a length of not less than the distance between the lines of rivets connecting them to the flanges, and intermediate ones of not less than one-half of this distance. The thickness of tie plates shall not be less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the members, and the rivet pitch shall not be more than four diameters. Tie plates shall be sufficient in size and number to equalize the stress in the parts of the members.

(b) Lattice bars shall have neatly finished ends. The thickness of lattice bars shall be not less than one-fortieth for single lattice and one-sixtieth for double lattice of the distance between end rivets; their minimum width shall be as follows:

For 15″ channels, or built sections with 3½″ and 4″ angles—2¼″ (¾″ rivets), or 2½″ (⅞″ rivets).

For 12″, 10″, and 9″ channels, or built sections with 3″ angles—2¼″ (¾″ rivets).

For 8″ and 7″ channels, or built sections with 2½″ angles—2″ (⅝″ rivets), or 2¼″ (¾″ rivets)

For 6″ and 5″ channels, or built sections with 2″ angles—1½″ (½″ rivets), or 1¾″ (⅝″ rivets).

(c) The inclination of lattice bars to the axis of the members shall generally be not less than 45° but when the distance between the rivet lines in the flanges is more than 15 inches, the lattice shall be double and riveted at the intersection if bars are used, or else shall be made of angles.

(d) Lattice bars shall be so spaced that the ratio $l/r$ of the flange included between their connections shall be not over ¾ of that of the member as a whole.

## 17. EXPANSION.

Proper provision shall be made for expansion and contraction.

## 18. MINIMUM THICKNESS.

No steel less than $\frac{5}{16}$ inch thick shall be used for exterior construction, nor less than ¼ inch for interior construction, except for linings or fillers and rolled structural shapes.

These provisions do not apply to light structures such as skylights, marquees, fire-escapes, light one-story buildings, or light miscellaneous steel work.

For trusses having end reactions of 35000 pounds or over, the Gusset Plates shall be not less than ⅜ inch thick.

## 19. ADJUSTABLE MEMBERS.

The initial stress in adjustable members shall be assumed as not less than 5000 lbs.

## 20. WORKMANSHIP.

(a) All workmanship shall be equal to the best practice in modern structural shops.

(b) Drifting to enlarge unfair holes shall not be permitted.

(c) The several pieces forming built sections shall be straight and fit close together; and finished members shall be free from twists, bends, or open joints.

(d) Rolled sections, except for minor details, shall not be heated.

(e) Wherever steel castings are used, they shall be properly annealed.

(f) **Punching.** Material may be punched $\frac{1}{16}$ inch larger than the nominal diameter of the rivets, whenever the thickness of the metal is equal to or less than the diameter of the rivets, plus $\frac{1}{8}$ inch. When the metal is thicker than the diameter of the rivet, plus $\frac{1}{8}$ inch, the holes shall be drilled, or sub-punched and reamed.

*(g) Rivets are to be driven hot, and wherever practicable, by power. Rivet heads shall be of hemispherical shape and uniform size throughout the work for the same size rivet, full, neatly finished, and concentric with the holes. Rivets, after driving, shall be tight, completely filling the holes, and with heads in full contact with the surface. Rivets shall be heated uniformly and their temperature before driving should not exceed 1950° F. which is a light yellow color. A gun should not be used for driving after the temperature is below 1000° F., which is a blood red color.

(h) Compression joints depending upon contact bearing shall have the bearing surfaces truly faced after the members are riveted. All other joints shall be cut or dressed true and straight, especially where exposed to view.

*(i) The use of a cutting torch is permissible if the metal being cut is not carrying stresses during the operation. Stresses shall not be transmitted through a flame cut surface. The radius of re-entrant flame cut fillets shall be as large as possible, but never less than 1″. To determine the net area of members so cut, $\frac{1}{8}$″ shall be deducted from the flame cut edges.

## 21. PAINTING.

*(a) Parts not in contact, but inaccessible after assembling, shall be properly protected by paint. Surfaces to be riveted in contact shall not be painted.

(b) All steel work, except where encased in concrete, shall be thoroughly cleaned and given one coat of acceptable metal protection well worked into the joints and open spaces.

(c) Machine finished surfaces shall be protected against corrosion.

(d) Field painting is a phase of maintenance, but it is important that unless otherwise properly protected, all steel work shall after erection be protected by a field coat of good paint applied by a competent painter.

*revised Nov. 1st, 1928.

**22. ERECTION.**

(a) The frame of all steel skeleton buildings shall be carried up true and plumb, and temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment, and the operation of same. Such bracing shall be left in place as long as may be required for safety.

(b) As erection progresses the work shall be securely bolted up to take care of all dead load, wind and erection stresses.

(c) Wherever piles of material, erection equipment, or other loads are carried during erection, proper provision shall be made to take care of stresses resulting from the same.

(d) No riveting shall be done until the structure has been properly aligned.

(e) Rivets driven in the field shall be heated and driven with the same care as those driven in the shop.

**23. INSPECTION.**

(a) Material and workmanship at all times shall be subject to the inspection of experienced engineers representing the purchaser.

(b) Material or workmanship not conforming to the provisions of this Specification shall be rejected at any time defects are found during the progress of the work.

(c) The Contractor furnishing such material or doing such work shall promptly replace the same.

(d) All inspection as far as possible shall be made at the place of manufacture, and the Contractor or Manufacturer shall co-operate with the Inspector, permitting access for inspection to all places where work is being done.

AMERICAN SOCIETY FOR TESTING MATERIALS
1315 Spruce Street, Philadelphia, Pa.

# STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL FOR BUILDINGS

**Serial Designation: A9-29**

These specifications are issued under the fixed designation A 9; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Adopted, 1901; Revised, 1909, 1913, 1914, 1916, 1921, 1924, 1929.

## I. MANUFACTURE

### Process

1. (a) Structural steel, except as noted in Paragraph (b), shall be made by either or both the following processes: Bessemer or open-hearth.

(b) Rivet steel, and steel for plates or angles over ¾ in. in thickness which are to be punched, shall be made by the open-hearth process.

## II. CHEMICAL PROPERTIES AND TESTS

### Chemical Composition

**2.** The steel shall conform to the following requirements as to chemical composition:

| | | Structural Steel | Rivet Steel |
|---|---|---|---|
| Phosphorus | Bessemer | not over 0.10 per cent | |
| | Open-hearth | not over 0.06 per cent | not over 0.06 per cent |
| Sulfur | | not over 0.045 per cent | |
| Copper, when copper steel is specified | | not under 0.20 per cent | not under 0.20 per cent |

### Ladle Analyses

**3.** (a) A carbon determination, and a copper determination, when copper steel is specified shall be made of each melt of bessemer steel, and determinations for manganese, phosphorus and sulfur representing the average of the melts applied for each 12-hour period.

(b) An analysis of each melt of open-hearth steel shall be made to determine carbon, manganese, phosphorus and sulfur; also copper when copper steel is specified.

(c) These analyses shall be made by the manufacturer from test ingots taken during the pouring of each melt. The chemical composition thus determined shall be reported to the purchaser or his representative and the percentages of phosphorus and sulfur and also copper when copper steel is specified shall conform to the requirements specified in Section 2.

### Check Analyses

**4.** Analyses may be made by the purchaser from finished material representing each melt. The phosphorus and sulfur content thus determined shall not exceed that specified in Section 2 by more than 25 per cent.

## III. PHYSICAL PROPERTIES AND TESTS

### Tension Tests

**5.** (**a**) The material shall conform to the following requirements as to tensile properties:

| Properties Considered | Structural Steel | Rivet Steel |
|---|---|---|
| Tensile strength, lb. per sq. in. | 55,000—65,000 | 46,000—56,000 |
| Yield point, min., per sq. in. | 0.5 tens. str. | 0.5 tens. str. |
| but in no case less than | 30,000 | 25,000 |
| Elongation in 8 in., min., per cent | $\frac{1,400,000}{\text{Tens. str.}}$ [a] | $\frac{1,400,000}{\text{Tens. str.}}$ |
| Elongation in 2 in., min., per cent | 22 | ..... |

[a] See Section 6.

(**b**) The yield point shall be determined by the drop of the beam of the testing machine.

### Modifications in Elongation

**6.** (**a**) For structural steel over $\frac{3}{4}$ in. in thickness, a deduction from the percentage of elongation in 8 in. specified in Section 5 (**a**) of 0.25 per cent shall be made for each increase of $\frac{1}{32}$ in. of the specified thickness above $\frac{3}{4}$ in., to a minimum of 18 per cent.

(**b**) For structural steel under $\frac{5}{16}$ in. in thickness, a deduction from the percentage of elongation in 8 in. specified in Section 5 (**a**) of 1.25 per cent shall be made for each decrease of $\frac{1}{32}$ in. of the specified thickness below $\frac{5}{16}$ in.

### Bend Tests

**7.** (**a**) Bend test specimens, except as specified in Paragraph (**b**), shall stand being bent cold through 180 deg. without cracking on the outside of the bent portion, as follows: For material $\frac{3}{4}$ in. or under in thickness, flat on itself; for material over $\frac{3}{4}$ in. to and including $1\frac{1}{4}$ in. in thickness, around a pin the diameter of which is equal to the thickness of the specimen; and for material over $1\frac{1}{4}$ in. in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen.

(**b**) Bend test specimens for rivet steel shall stand being bent cold through 180 deg. flat on themselves without cracking on the outside of the bent portion.

### Test Specimens

**8.** (**a**) Test specimens shall be prepared for testing from the material in its rolled or forged condition, except as specified in Paragraphs (**b**) and (**c**).

(**b**) Test specimens for annealed material shall be prepared from the material as annealed for use, or from a short length of a full section similarly treated.

(**c**) Test specimens for rivet bars which have been cold-drawn shall be normalized before testing.

(d) Test specimens shall be taken longitudinally and, except as specified in Paragraphs (f), (g), and (h), shall be of the full thickness or section of material as rolled.

(e) Test specimens for plates, shapes and flats may be machined to the form and dimensions shown in Fig. 1, or with both edges parallel.

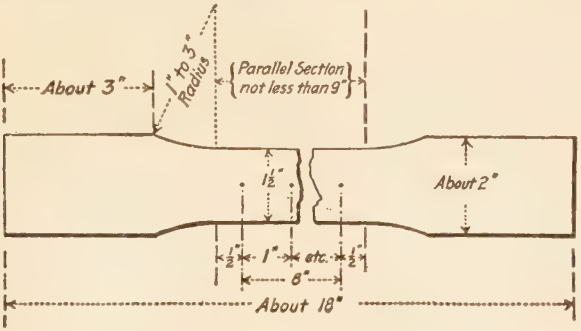
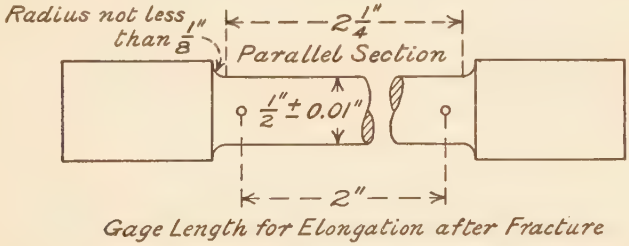



FIG 1.

(f) Tension test specimens for material over 1½ in. in thickness or diameter, except pins and rollers, may be machined to a thickness or diameter of at least ¾ in. for a length of at least 9 in., or they may conform to the dimensions shown in Fig. 2.




*Note:-The Gage Length, Parallel Section, and Fillets shall be as Shown, but the Ends may be of any Shape to fit the Holders of the Testing Machine in such a Way that the Load shall be axial.*

FIG. 2.

(g) Bend test specimens for material over 1½ in. in thickness or diameter, except pins and rollers, may be machined to a thickness or diameter of at least ¾ in. or to 1 by ½ in. in section.

(h) Tension test specimens for pins and rollers shall conform to the dimensions shown in Fig. 2, and bend test specimens shall be 1 by ½ in. in section.

(i) Test specimens for pins and rollers shall be taken so that the axis is 1 in. from the surface.

(j) The machined sides of rectangular bend test specimens may have the corners rounded to a radius not over $\frac{1}{16}$ in.

### Number of Tests

**9.** (**a**) One tension and one bend test shall be made from each melt; except that if material from one melt differs ⅜ in. or more in thickness, one tension and one bend test shall be made from both the thickest and the thinnest material rolled.

(**b**) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(**c**) If the percentage of elongation of any tension test specimen is less than that specified in Section 5 (**a**) and any part of the fracture is more than ¾ in. from the center of the gage length of a 2-in. specimen or is outside the middle third of the gage length of an 8-in. specimen, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

## IV. PERMISSIBLE VARIATIONS IN WEIGHT AND THICKNESS

### Permissible Variations

**10.** (**a**) The cross-section or weight of each piece of steel shall not vary more than 2.5 per cent from that specified; except in the case of sheared plates, which shall be covered by the permissible variations specified in Paragraphs (**b**) and (**c**). (One cubic inch of rolled steel is assumed to weigh 0.2833 lb.)

(**b**) **Sheared Plates, When Ordered to Weight per Square Foot:** The weight of each lot[1] in each shipment shall not vary from the weight ordered more than the amount given in Table I.

(**c**) **Sheared Plates, When Ordered to Thickness:** The thickness of each plate shall not vary more than 0.01 in. under that ordered.

The overweight of each lot[1] in each shipment shall not exceed the amount given in Table II.

## V. FINISH

### Finish

**11.** The finished material shall be free from injurious defects and shall have a workmanlike finish.

## VI. MARKING

### Marking

**12.** The name or brand of the manufacturer and the melt number shall be legibly stamped or rolled on all finished material, except that rivet and lattice bars and other small sections shall, when loaded for shipment, be properly separated and marked for identification. The identification marks shall be legibly stamped on the end of each pin and roller. The melt number shall be legibly marked, by stamping if practicable, on each test specimen.

[1] The term "lot" as applied to Table I means all of the plates of each group width and group weight; as applied to Table II, it means all of the plates of each group width and group thickness.

## VII. INSPECTION AND REJECTION

### Inspection

**13.** The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

### Rejection

**14.** (**a**) Unless otherwise specified, any rejection based on tests made in accordance with Section 4 shall be reported within five working days from the receipt of samples.

(**b**) Material which shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

### Rehearing

**15.** Samples tested in accordance with Section 4, which represent rejected material, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

## Table I.—Permissible Variations of Rectangular Plates Ordered to Weight.

| Ordered Weight, Lb. per Sq. Ft. | Permissible Variations in Average Weights per Square Foot of Plates for Widths Given, Expressed in Percentages of Ordered Weights | | | | | | | | | | | | | | | | | | Ordered Weight, Lb. per Sq. Ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Under 48 in., | | 48 to 60 in., excl. | | 60 to 72 in., excl. | | 72 to 84 in., excl. | | 84 to 96 in., excl. | | 96 to 108 in., excl. | | 108 to 120 in., excl. | | 120 to 132 in., excl. | | 132 in. or over | | |
| | Over | Under | Over | Under | Over | Under | Over | Under | Over | Under | Over | Under | Over | Under | Over | Under | Over | Under | |
| Under 5 | 5 | 3 | 5.5 | 3 | 6 | 3 | 7 | 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | Under 5 |
| 5 to 7.5 excl. | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 6 | 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 5 to 7.5 excl. |
| 7.5 to 10 " | 4 | 3 | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 6 | 3 | 7 | 3 | 8 | 3 | .... | .... | .... | .... | 7.5 to 10 " |
| 10 to 12.5 " | 3.5 | 2.5 | 4 | 3 | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 6 | 3 | 7 | 3 | 8 | 3 | 9 | 3 | 10 to 12.5 " |
| 12.5 to 15 " | 3 | 2.5 | 3.5 | 2.5 | 4 | 3 | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 6 | 3 | 7 | 3 | 8 | 3 | 12.5 to 15 " |
| 15 to 17.5 " | 2.5 | 2.5 | 3 | 2.5 | 3.5 | 2.5 | 4 | 3 | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 6 | 3 | 7 | 3 | 15 to 17.5 " |
| 17.5 to 20 " | 2.5 | 2 | 2.5 | 2.5 | 3 | 2.5 | 3.5 | 2.5 | 4 | 3 | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 6 | 3 | 17.5 to 20 " |
| 20 to 25 " | 2 | 2 | 2.5 | 2 | 2.5 | 2.5 | 3 | 2.5 | 3.5 | 2.5 | 4 | 3 | 4.5 | 3 | 5 | 3 | 5.5 | 3 | 20 to 25 " |
| 25 to 30 " | 2 | 2 | 2 | 2 | 2.5 | 2 | 2.5 | 2.5 | 3 | 2.5 | 3.5 | 3 | 4 | 3 | 4.5 | 3 | 5 | 3 | 25 to 30 " |
| 30 to 40 " | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 | 2 | 2.5 | 2.5 | 3 | 2.5 | 3.5 | 3 | 4 | 3 | 4.5 | 3 | 30 to 40 " |
| 40 or over | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 | 2 | 2.5 | 2.5 | 3 | 2.5 | 3.5 | 3 | 4 | 3 | 40 or over |

**Note.**—The weight per square foot of individual plates shall not vary from the ordered weight by more than $1\frac{1}{3}$ times the amount given in this table.

**Table II.—Permissible Overweights of Rectangular Plates Ordered to Thickness**

| Ordered Thickness, In. | Permissible Excess in Average Weights per Square Foot of Plates for Widths Given, Expressed in Percentages of Nominal Weights | | | | | | | | | Ordered Thickness, In. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Under 48 in. | 48 to 60 in., excl. | 60 to 72 in., excl. | 72 to 84 in., excl. | 84 to 96 in., excl. | 96 to 108 in., excl. | 108 to 120 in., excl. | 120 to 132 in., excl. | 132 in. or over | |
| Under 1/8 | 9 | 10 | 12 | 14 | ..... | ..... | ..... | ..... | ..... | Under 1/8 |
| 1/8 to 3/16 excl. | 8 | 9 | 10 | 12 | ..... | ..... | ..... | ..... | ..... | 1/8 to 3/16 excl. |
| 3/16 to 1/4 " | 7 | 8 | 9 | 10 | 12 | ..... | ..... | ..... | ..... | 3/16 to 1/4 " |
| 1/4 to 5/16 " | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 19 | 1/4 to 5/16 " |
| 5/16 to 3/8 " | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 17 | 5/16 to 3/8 " |
| 3/8 to 7/16 " | 4.5 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 3/8 to 7/16 " |
| 7/16 to 1/2 " | 4 | 4.5 | 5 | 6 | 7 | 8 | 9 | 10 | 13 | 7/16 to 1/2 " |
| 1/2 to 5/8 " | 3.5 | 4 | 4.5 | 5 | 6 | 7 | 8 | 9 | 11 | 1/2 to 5/8 " |
| 5/8 to 3/4 " | 3 | 3.5 | 4 | 4.5 | 5 | 6 | 7 | 8 | 9 | 5/8 to 3/4 " |
| 3/4 to 1 " | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 6 | 7 | 8 | 3/4 to 1 " |
| 1 or over | 2.5 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 6 | 7 | 1 or over |

# CODE OF STANDARD PRACTICE

## PREFACE

Since the use of structural steel came into existence about 1890, there has developed an industry engaged in the fabrication and erection of this material. At the present time this industry is furnishing annually over $300,000,000 worth of material to the public.

During this period of evolution it is obvious that many inconsistent practices should have come into existence, and the American Institue of Steel Construction, representing the industry between the rolling mills and the buying public, have undertaken the codifying of the various conditions, with a view of establishing uniform practice.

The Institute's Specification on the design, fabrication, and erection of structural steel has been received with wide spread approval, and this Code of Standard Practice is now being issued to cover conditions not touched in the Specification.

# CODE OF STANDARD PRACTICE

**As adopted by the**
**American Institute of Steel Construction, Inc.**

## SECTION 1. GENERAL

**(a) Scope.**

The rules and practices hereinafter defined are adopted by the American Institute of Steel Constuction as standard for the industry and shall govern all conditions where the contract between the buyer and seller does not specify otherwise and where they do not conflict with local or state requirements.

**(b) Design.**

Unless otherwise specified or required, the design, fabrication and erection of structural steel shall conform to the Standard Specification of the American Institute of Steel Construction for buildings, dated June 1, 1923, or as amended to date.

**(c) Plans and Specifications for bidding.**

The plans shall show a complete design with sizes, sections and the relative location of various members with floor levels, column centers and offsets figured, and shall show the character of the work to be performed with sufficient dimensions to permit the making of an accurate estimate of cost. Plans shall be made to scale not less than $\frac{1}{8}$" to the foot, and large enough to convey the information adequately.

Wind bracing and special details when required shall be shown in sufficient detail regarding rivets and construction to permit an accurate estimate of cost.

**(d) Responsibility of Design and Erection.**

If the design, plans and specifications are prepared by the Buyer, the Seller shall not be responsible for the suitability, strength, rigidity or the practicability of erection.

## SECTION 2. CLASSIFICATION

The Steel and iron items entering into the construction of a structure are divided into the following classes:

CLASS "A"—Structural Steel and Iron
CLASS "B"—Ornamental Steel and Iron
CLASS "C"—Steel Floor Joists
CLASS "D"—Miscellaneous Steel and Iron

In contracting to furnish the material for a structure where the material to be furnished is designated as structural steel and iron, ornamental steel and iron, steel floor joists, or miscellaneous steel and iron, the Seller will furnish only such items under each classification as are listed below, and no other items will be included unless by special agreement. In cases where materials in excess of minimum requirements are furnished to provide for waste or loss, all unused material remaining after completion of work shall be the property of the Seller and returned to him.

Unless specifically agreed to in the contract, the Seller of the structural steel "Class A" will not provide field connections or field holes for the ornamental steel and iron "Class B," the miscellaneous steel and iron "Class D," nor the materials for any other trades.

**(a) Class "A" Structural Steel and Iron.**

Contracts taken to furnish the structural steel and iron for a building are based on furnishing the following items only:

Anchors for structural steel only
Bases of steel or iron only
Beams of rolled structural steel
Bearing plates for structural steel
Brackets made of structural steel shapes
Channels of rolled structural steel
Channels and angle supports only for suspended ceilings where they attach to structural steel, but not including small channel or angle furring
Columns, structural steel, cast iron and pipe
Girders of structural steel
Grillage beams and girders—structural steel
Hangers of structural steel
Lintels as shown or enumerated
Marquise (structural frame only)
Rivets and bolts for field connections, as follows:

1. The Seller shall furnish sufficient rivets of suitable size, plus at least 10% to cover waste for all field connections of steel to steel which are designated as riveted field connections.
2. The Seller shall furnish sufficient bolts of suitable size, plus 5% to cover waste for all field connections of steel to steel which are designated to be bolted.
3. No fitting up bolts or washers will be included unless specifically called for.

Separators, angles, tees, clips, bracing and detail fittings in connection with structural steel frame
Tie rods
Trusses of structural steel

**(b) Class "B" Ornamental Steel and Iron.**

Contracts taken to furnish the ornamental steel and iron for a building are based on furnishing the following items only:

All bronze and brass work, except hardware fittings
Balconies
Cast iron cornices
Curtain guides
Elevator fronts and enclosures
Grilles and gratings
Iron store fronts
Lamp standards and brackets
Marquise (steel or iron, except frame) see Class "A"

Ornamental brackets, steel or iron
Ornamental inside stairs, steel or iron
Ornamental outside steel or iron stairs, including fire escapes
Safety treads
Railings (gas pipe, ornamental or brass)
Sills and thresholds (brass, steel or iron)
Spiral stairs, steel or iron
Window sills and frames, steel or iron
Wire work, ornamental steel or iron

**(c) Class "C" Steel Floor Joists.**

Contracts taken to furnish the steel floor joists for a building are based on furnishing the following items only:

Steel joists which are not a part of the structural steel frame for the building, and which are devised to carry the floor or roof panels.
Bracing and bridging for floor joists; clips for fastening floor joists
Stirrup and hanger for floor joists
Ties for floor joists

**(d) Class "D" Miscellaneous Steel and Iron.**

The nature and character of the material of this classification makes it impossible to cover all items and it is recommended that the Seller taking the contract to furnish the miscellaneous steel and iron work for a building specify all items in detail which it is intended to furnish. The general list of items under this classification is as follows:

Area gratings
Cast iron cover and frames
Cast iron rainwater receivers
Cast iron downspout shoes
Cleanouts
Coal chutes
Column guards
Door frames and bucks
Foot scrapers
Furnace or fireplace dampers
Flag pole
Ladders
Pin rails
Sidewalk doors
Sills and curb angles, and anchors for same
Special bolts or anchors where distinctly shown on the plans
Stairs made of plain structural steel—not including treads of other materials
Stacks
Steel and cast iron platforms
Steel or iron chimney caps
Thimbles
Wall plate anchors

Wheel guards
Window guards
Wire screens for partitions, door and window guards (this does not include fly screens)

**(e) Materials not classed under above headings.**

The following items are not covered by classifications A-B-C and D and will in no case be furnished by the Seller unless specifically agreed to and mentioned in the contract. It is not possible to designate every detail and the list is typical of material not included in classifications A-B-C and D. It is shown here to assist the Architect and Engineer in avoiding confusion.

Ash hoists
Awning boxes
Boilers
Elevators or accessories
Elevator guides or sheave beams
Expanded metal
Furring
Glass for any purpose whatever
Hollow metal doors or frames
Hoppers
Mail chute
Metal lockers
Miscellaneous carpenter or masonry bolts for connecting wood to wood steel to wood, or wood to stone, etc.
Name plates
Patented devices
Pilot and driving nuts
Reinforcing steel
Rolling doors
Sheet metal work or corrugated sidings and roofing
Sidewalk lights
Steel sash and steel sash partitions
Spiral slides
Suspended ceiling, except as noted under Class "A"
Tanks and pans
Toilet partitions
Treads, except steel or iron
Vault doors
Ventilating brick
Wall, ceiling and floor registers
Wood handrails
Wood handrail brackets
And all other material not mentioned

## SECTION 3. INVOICING

When conditions make it possible to award contracts on a lump sum basis the confusion of determining weights will be avoided. Scale weights involve a variation which frequently lead to a compromise based on calculated weights.

The rules hereinafter established, while not giving exact weights, are the basis upon which the Seller must make a lump sum or a pound price bid and they eliminate the necessity of increased cost of shop drawings and other refinements of manufacture which would very materially increase costs if exact weights were required.

**(a) Weights.**

Structural steel and iron sold at a unit price per pound, hundred weight (100 #) or ton (2000 #) shall be invoiced on the calculated weights of shapes, plates, bars, castings, rivets and bolts, based on the detailed shop drawings and shop bills of material which show actual dimensions of materials used as follows:

Dimensions:—

The weight will be figured on the basis of rectangular dimensions for all plates, and ordered overall lengths for all structural shapes and with no deductions for copes, clips, sheared edges, punchings, borings, milling or planing. When parts can be economically cut in multiples from material of larger dimension, the calculated weight shall be taken as that of the material from which the parts are cut.

Over-run, as follows:—

1. To the nominal theoretical weight of all universal mill and sheared plates or slabs will be added one-half the allowance for variation or over-weight in accordance with the specifications of the American Society for Testing Materials. All plates less than 5 feet in length shall be subject to the variation or over-weight given for sheared plates. (See table in A. S. T. M. Specification).
2. Reinforcing bars when not sold on a basis of scale weights shall be invoiced by the Seller at the theoretical weights plus 1½% to allow for over-run weight of deformations, etc.
3. The calculated weights of castings shall be the weights determined from the detail drawings of the pieces including standard fillets for such pieces. To this an average over-run of 10% shall be added.

Rivets, as follows:—

1. The weight of shop rivets will be based on the weights shown in the following table:

| | | |
|---|---|---|
| Rivets ½" | in diameter | 20 # per 100 rivets |
| Rivets 5/8" | in diameter | 30 # per 100 rivets |
| Rivets ¾" | in diameter | 50 # per 100 rivets |
| Rivets ⅞" | in diameter | 100 # per 100 rivets |
| Rivets 1 " | in diameter | 150 # per 100 rivets |
| Rivets 1⅛" | in diameter | 250 # per 100 rivets |
| Rivets 1¼" | in diameter | 325 # per 100 rivets |

2. Field rivets and bolts shall be invoiced at their actual weight.

Paint:—

One-half of 1% of the theoretical weights of the material painted will be added for each coat of paint. For work oiled, one-fourth of 1% for each coat will be added.

## SECTION 4. DRAWINGS AND SPECIFICATIONS

(a) The Buyer shall furnish the Seller within a time agreed to in the contract a survey of the lot lines, together with a complete and full design of the structural steel frame definitely locating all openings, levels, etc.; and showing all material to be furnished by the Seller with such information as may be necessary for the completion of the shop drawings by the Seller. All such information and drawings shall be consistent with the original drawings and specifications.

(b) In case of discrepancies between the drawings and the specifications prepared by either the Seller or the Buyer, the specification shall govern; and in case of discrepancies between the scaled dimensions on the drawings and the figures written on them, the figures shall govern.

Should the Seller in the execution of his work find discrepancies in the information furnished by the Buyer, he shall refer such discrepancies to the Buyer before proceeding further with work which would be affected.

(c) Shop Drawings shall be made and submitted to the representative of the Buyer, who shall examine the same and return them approved with such corrections as he finds necessary. They shall be corrected by the Seller if necessary and returned for the Buyer's file as finally approved. The Seller may proceed with shop work, but in so doing he shall assume responsibility for having properly made the corrections indicated by the Buyer.

In addition to the set of blue prints of approved shop drawings for the Buyer's file as above referred to, the Buyer may require the Seller to furnish without cost to the Buyer, one additional set of shop drawing blue prints, but any further additional sets shall be paid for by the Buyer at cost, plus overhead and a fixed per cent for profit. All drawings or tracings made by the Seller for the execution of his work shall remain his property unless otherwise specifically agreed to.

(d) Shop Drawings prepared by the Seller and approved by a representative of the Buyer shall be deemed the correct interpretation of the work to be done, but does not relieve the Seller of responsibility for the accuracy of details.

(e) After the plans and shop drawings have been "approved" or "approved as noted" by the authority designated in the contract, any further changes required shall be made at the expense of the Buyer.

(f) When detailed shop drawings are furnished by the Buyer no responsibility for misfits due to errors in the drawings will be assumed by the Seller.

## SECTION 5. GOOD WORKMANSHIP AND STANDARD PRACTICE

Good workmanship and standard practice in a modern structural shop is defined as follows:

(a) Material.

Stock material shall be of a quality substantially equal to that called for by the specifications of the American Society for Testing Materials for the classifications covering its intended use; and mill test reports shall constitute sufficient record as to the quality of material carried in stock. It is obviously

impossible for the Seller to maintain records of heat or blow numbers of every piece of material in his stock, and the same shall not be required if all his stock purchases are made under an established specification as to grade and quality.

Whenever a shop maintains such a practice in carrying a stock of material, it is deemed good practice to permit the use of such stock material in its fabricating operations whenever the shop desires to do so, instead of ordering items from the mill for a specific operation. Stock materials bought under no particular specifications, or under specifications materially less rigid than those mentioned above, or stock material which has not been subject to mill or other recognized test reports, shall not be used, except as noted below, without the approval of the Buyer and under rigid inspection.

It is permitted to use unidentified stock material free from surface imperfections for short sections of minor importance or for small unimportant details, where the quality of the material could not affect the strength of the structure.

**(b) Straightening and Cleaning.**

All material shall be clean and straight, and if straightening or flattening is necessary, it shall be done by a process that will not injure the material. Sharp kinks or bends shall be cause for rejection.

**(c) Punching.**

The punch shall be $\frac{1}{16}''$ larger than the nominal diameter of the rivet, and the die opening not more than $\frac{1}{8}''$ larger than the diameter of the punch. The thickness of the material in punched work shall not be greater than nominal diameter of the rivet, plus $\frac{1}{8}''$. The accuracy of the punching shall be such that for any group of holes when assembled, 75% shall admit a rod equal to the diameter of the cold rivet at right angles to the plane of the connection, otherwise the holes shall be reamed.

Likewise, when work is assembled, all holes which will not admit a rod $\frac{1}{8}''$ smaller than the nominal diameter of the cold rivet shall be reamed.

**(d) Reaming.**

Reamed or drilled holes shall not be required unless specifically agreed to in the contract. When specifications require that work shall be sub-punched and reamed the die used for punching shall be $\frac{1}{16}''$ smaller than the nominal diameter of the rivet, and the assembled holes shall be reamed to a diameter of $\frac{1}{16}''$ larger than the nominal diameter of the rivet.

**(e) Planing.**

Planing or finishing of sheared plates or shapes will not be required unless specifically called for by the specifications or drawings.

**(f) Assembling.**

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting done during assembling shall not distort the metal to enlarge the hole on the side on which the die was used in punching.

Finished members shall be true to line and free from twists, bends and open joints. It is not the function of fitting up bolts to bring improperly straightened material into place, thus causing a strain on the rivets in the finished work.

Compression members shall not have a lateral variation greater than 1 to 1000 of the axial length between the points which are to be laterally supported.

An allowable variation of $\frac{1}{32}$" is permissible in the over all length of members with both ends milled.

Members without milled ends which are to be assembled to other steel parts of the structure shall not have an error greater than $\frac{1}{16}$" for members 30 feet or less in length, and not more than $\frac{1}{8}$" for members over 30 feet in length.

**(g) *Riveting.**

Rivets shall be heated uniformly and their temperature before driving should not exceed 1950° F. which is a light yellow color. A gun should not be used for driving after the temperature is below 1000° F., which is a blood red color. Rivets shall be driven and the heads formed with a proper sized die while hot. When heated and ready for driving, rivets shall be free from slag scale and carbon deposits. When driven they shall completely fill the holes.

Loose, burned or otherwise defective rivets shall be replaced. After driving, the rivet heads shall be full, neatly made, concentric with the rivet hole, and in full contact with the surface of the member. Caulking the rivet head shall not be permitted.

***(h) Cutting Torch.**

The use of a cutting torch is permissible if the metal being cut is not carrying stresses during the operation. Stresses shall not be transmitted through a flame cut surface. The radius of re-entrant flame cut fillets shall be as large as possible, but never less than 1". To determine the net area of members so cut, $\frac{1}{8}$" shall be deducted from the flame cut edges.

## SECTION 6. INSPECTION AND DELIVERY

**(a) Inspection.**

The Seller's shop service includes inspection by his own inspectors, and shop or mill inspection other than this shall be paid for by the Buyer.

**(b) Acceptance of Materials.**

When material is inspected by a representative of the Buyer at the Shop, the acceptance of such material by the Buyer's representative shall be considered the Buyer's final approval; but the Seller shall be responsible for the accuracy of the work and for defective material or workmanship which may be discovered before the completion of the structure.

**(c) Order of Delivery.**

Unless the order or sequence of delivery is specifically arranged for before the work is undertaken, it will be at the convenience of the Seller.

**(d) Materials sold delivered.**

When material is sold delivered on cars or trucks at the site of the structure, all unloading shall be done by the Buyer, and all responsibility to persons or property during such unloading shall be at the Buyer's risk.

*Revised 1928.

**(e) Loss in shipment where material is sold fabricated only.**

The quantity of material shown by the shipping statement will in all cases govern settlements unless notice of shortage is immediately reported to the agent of the delivering carrier, and his signed verification obtained, and like notice sent to the Seller within 48 hours after receipt of the shipment, in order that the alleged shortage may be investigated by the Seller.

**(f) Storage of Material.**

Where conditions make it necessary that material be stored for any length of time, and the contract does not provide for such storage, payments are to come due and be payable the same as if the material had been delivered at the building site; and the Seller shall be compensated for handling, storage, and other increased expenses that may result from such conditions.

## SECTION 7. ERECTION

**(a) Foundations.**

The Seller or erector shall not be responsible for the strength or suitability of the foundations.

**(b) Building Lines and Bench Marks.**

Building lines and bench marks at the site of the structure shall be accurately located by the Buyer, and carefully shown or described by him or his representative to the steel erector or his engineer.

**(c) Steel and Cast Iron Bases.**

All steel grillage, steel slabs, cast iron, or steel bases, or steel columns with bases fabricated as an integral part of the column shall be set and wedged or shimmed by the seller or steel erector to grade or level lines, which are determined and fixed by the buyer, who shall grout all such parts in place. Before grouting the buyer shall check the grades and levels of the parts to be grouted, and shall be responsible for the accuracy of the same.

**(d) Anchor Bolts.**

All anchor or foundation bolts shall be set by the Buyer.

**(e) Working Room.**

The erection contractor shall be entitled to sufficient space at the site of the structure at a place convenient to him to place his derricks and other equipment necessary for erection. When conditions at the site provide working space not occupied by the structure, the erection contractor shall be entitled to storage space for sufficient material to keep his working force in continuous operation.

**(f) Plumbing Up.**

The temproary guys and braces shall be the property of the Seller, and if after the steel has been plumbed and leveled, the work of completing the structure by other contractors is suspended or delayed the owner of the temporary guys and braces shall receive reasonable compensation for their use. The guys shall be removed by the Buyer at his expense, and returned to the Seller in as good condition as when placed in the building with a reasonable depreciation.

Immediately upon completion by the steel erector, the Buyer shall assure himself by whatever agencies he may elect, that the steel erector's work is plumb and level, and properly guyed. If it is not, he should immediately notify the erector and direct him to perfect his work. After the steel erector has guyed and plumbed the work once to the satisfaction of the Buyer, his responsibility ceases. Any further work in guying or plumbing shall be performed entirely at the Buyer's expense.

In the setting or erecting of structural steel work, the individual pieces shall be considered plumb or level where the error does not exceed 1 to 500.

For exterior columns and columns adjacent to elevator shafts of multiple story buildings, the error from plumb shall not exceed 1 to 1000 for the total height of the column.

**(g) Opportunity to Investigate Errors.**

Correction of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets will be considered as a legitimate part of erection. Any error in shop work which prevents the proper assembling and fitting up of parts by the moderate use of drift pins, or a moderate amount of reaming and slight chipping or cutting, shall immediately be reported to the Seller and his approval of the method of correction obtained.

**(h) Wall Plates.**

All loose masonry bearing plates for beams, lintels, trusses or columns shall be set and grouted to grade and line by the Buyer ready for the steel erector to set his work.

**(i) Loose Lintels.**

Loose lintels or pieces of all kinds and descriptions required by the design of a building to carry brick work over openings, and which lintels or pieces are not attached in any way to the rest of the steel structure, and cannot be placed except as the masonry work advances, will not be erected by the steel erector unless by special agreement.

**(j) Ornamental Iron and Bronze.**

Fine ornamental iron and bronze work is considered as finishing material, and shall not be set in a building until after the marble, plaster, and other work, except decorating, is in place.

**(k) Elevator Framing.**

The setting or erection of guides, cars, machinery, cables, sheaves, pans, etc., for elevators, is not to be required of the steel erector.

**(l) Field Assembling.**

The size of assembled pieces of structural steel is fixed by the permissible weight and clearance dimensions of transportation. Unless such conditions are provided for by the Buyer or his engineer, the Seller shall provide for such field connections as will require the least field work; and such field connections shall be a part of the erection work.

**(m) Cutting and Patching.**

The Seller shall not be required to cut or patch any work, except his own,

unless particularly specified, and will not alter his own work required by changes or inaccuracies in the building without being reimbursed for the expense of such changes.

**(n) Insurance.**

The erector shall indemnify and save harmless the Buyer from all claims and costs arising from any damages to person or property occurring in the performance of his work due to any act or neglect of his employees or agents.

**(o) Temporary Floors.**

The Buyer shall provide plank, and cover all floors required by municipal or state laws, excepting the floor upon which the erecting derricks are located. This floor will be covered by the steel erector for working purposes.

**(p) Field Paint.**

Unless specifically agreed to in the contract, field paint shall be considered a phase of maintenance, and such protection as is necessary shall be provided for by the Buyer.

## SECTION 8. DELAYS IN PROSECUTION OF WORK

**(a) Causes not controlled by Seller or Buyer.**

Neither Seller nor Buyer shall be responsible for delays in performance caused by delays at rolling mills, or in transportation, or due to strikes, fires, floods, storms, or other circumstances beyond their reasonable control whether related or unrelated, or similar or dissimilar to any of the foregoing. In case of delay to work due to any of the above causes, a reasonable extension of time shall be given for the completion of the work.

**(b) Delays caused by the Seller.**

Should the Seller at any time, except as provided in the preceding paragraphs, refuse or neglect to supply enough workmen of proper skill or material of proper quality, or to carry on the work with promptness and diligence, the Buyer, if not in default, may give the Seller ten days written notice, and at the end of that time if the Seller continues to neglect the work, the Buyer may provide such labor or materials and deduct the cost from any money due or to become due the Seller under the contract, or may terminate the employment of the Seller under the agreement and take possession of the premises and of all materials, tools, and appliances thereon and employ any other person to finish the work. In the latter case, the Seller shall receive no further payment until the work be finished; then if the unpaid balance that would be due under the contract exceeds the cost to the Buyer of finishing the work, such excess shall be paid to the Seller; but if such cost exceeds unpaid balance, the Seller shall pay the excess to the Buyer.

**(c) Delays caused by the Buyer.**

The Buyer shall be responsible for delays resulting from lack of complete data and from changes or revisions or the tardy approval of drawings. Information given later than the date fixed in the contract for the delivery of complete

information shall not be cause for a claim by the Seller unless such delay affects Seller's costs or manufacturing operations. When such delays increase costs or compel changes in the Seller's manufacturing operations he shall be recompensed for the damage resulting.

If information is available for the Seller to manufacture or erect the material in accordance with the conditions of the contract, and if he is prevented from the orderly and continuous prosecution of such work by any act or a neglect of the Buyer, the Seller may continue his work and may place fabricated material in storage at his own plant or elsewhere and the Buyer shall, upon tender of transfer of title, pay for said material as if it had been delivered under the terms of the contract. The Buyer shall also recompense the Seller for all expense incurred in the storing, caring for, or re-handling of said material; and for damage resulting from changed manufacturing operations. On erection work the Seller shall be recompensed for any extra expense incurred in wages and in the transportation of men or equipment to and from the site and their maintenance at the site during the period of delay, also for extra expense resulting from overtime made necessary by such delay.

If for more than one month at any time, any act or neglect of the Buyer, or any legal proceeding taken against him, prevents the starting or continuous prosecution of the work, the Seller may give the Buyer ten days written notice, and at the end of that time, if the Buyer continues at fault or the legal proceeding continues effective, the Seller may terminate his obligations under the contract; in which case the Buyer shall at once pay the Seller for the work done and material provided, and all damages the Seller may sustain, including damages resulting from changed shop operations.

## SECTION 9. EXTRA WORK

### (a) General.

Charges for extra work, or work not covered by the contract, shall be made on a basis that is definitely and mutually understood between the Buyer and the Seller at the time the occasion for such extra expense arises.

In the absence of such an understanding between the Buyer and Seller, the following is listed as proper expenses.

### (b) Material.

All extra material required shall be invoiced out at current warehouse prices, plus cost of fabrication, including regular overhead costs, plus transportation costs, and an agreed per cent for profit.

### (c) Drafting Labor.

All extra labor in the drafting room shall be invoiced out at cost plus overhead, plus an agreed per cent for profit.

### (d) Shop Work.

All extra shop labor shall be charged at actual cost as shown by the time cards; to this shall be added the overhead expense, and the use of equipment and power. The sum of these charges shall be considered the actual cost of the shop, to which shall be added an agreed per cent for profit.

**(e) Field Work.**

All extra labor required in the erection of structural steel shall be invoiced as follows:

The actual labor cost shall be that shown by the time cards, to which shall be added the actual cost of insurance, the cost of labor transportation when necessary, and an additional allowance for overhead expense. The sum of these shall be considered the actual cost, to which shall be added an agreed per cent of profit.

Should the buyer or his agent or other trades engaged in the erection of other work connected with the structure require the use of materials or equipment belonging to the Seller, the Seller shall receive compensation for such extra service together with depreciation of equipment and an agreed per cent for profit.

**(f) Miscellaneous.**

Any additional cost, such as hauling, painting, crating, freight, etc., shall be charged at actual cost, plus overhead, plus insurance, plus an agreed per cent for profit.

**(g) Overtime.**

On contract work where the Seller has not agreed to work overtime, he shall not be required to do so without being paid for his extra expense and a profit.

**(h) Extra Cleaning.**

If because of continued storage, or for any other reason not the fault of the Seller, it should be necessary to clean and repaint the steel work, the cost of this additional cleaning and painting should be paid for as an extra, including regular overhead charges as specified for extra work elsewhere in this section.

## SECTION 10. PROPOSALS AND CONTRACTS

**(a) Direct Contracts.**

It is recommended that in all cases where the structural steel frame of a building is self supporting, and also in all such other cases where the structural steel and iron items entering into the construction of a building can easily be separated from the other materials of construction, that all contracts for such structural steel or iron be made separately by the owner or his representative with the steel contractor.

**(b) Conflicts.**

In the event of a conflict between the terms and conditions of the proposal, and the terms and conditions stated in the plans and specifications, the terms of the proposal shall govern.

**(c) Price for additions or deductions.**

The Seller is not to be required nor expected to make the same unit price for additions to as for deductions from the list of material required for a structure. The contract, may however, specify a certain other unit price for such materials as may be deducted from the quantity of material as originally contemplated by the contract.

**(d) Material not shown or called for.**

Clauses in the specification to the effect that all steel and iron items necessary to complete the structure shall be furnished by the Seller, whether or not they are shown on the plans or called for in the specifications, being obviously unfair, will not be recognized or subscribed to. The Seller shall, however, furnish all material and labor for details that may be required for such steel and iron work as is shown on the drawings or called for in the specification, although such details may themselves not be shown or called for.

**(e) Items not to be furnished.**

Unless specifically mentioned in the request for bids, or specifically agreed to, the bidders do not estimate or include the following items in their proposals:

Any charges for surety bonds or insurance not required by law, or any other general charge such as building permits, license fees or taxes for permission to work in city or state, engineering fees, removal of rubbish, patching or repairing of plaster or masonry work, office or telephone service, light, heat, fire insurance, or the erection of temporary structures, enclosures or stairs.

**(f) Terms.**

The following terms of payment are adopted as standard and will govern in all cases, except when otherwise agreed to in the contract.

1. All payments shall be made in funds current at par in the city in which the Seller furnishing the material is located.

2. All materials for export, net cash in exchange for shipping documents will be required.

3. For all materials to be erected by the Seller, the Buyer shall on the 10th day of each month pay an amount equal to not less than 90% of the contract value of all materials shipped, stored or ready for shipment; and not less than 90% of the contract value of the erection performed during the preceding month; and shall pay the remainder within 10 days after the completion of the steel contract; but the amount reserved by the Buyer shall at no time exceed double the contract value of the work remaining yet to be done.

4. When the material which is not to be erected by the Seller is sold to a Buyer whose credit has been established with the Seller, terms net cash for contract value of each shipment. Payments to be made on the 10th day of the month following shipments.

5. Unless otherwise agreed to, when material is sold delivered at, or freight is allowed to destination, the Buyer shall pay freight charges and the Seller shall accept receipted freight bills as cash to apply on matured payments due on or after arrival at destination of materials covered by such freight expense bills.

6. Payments shall all be considered to be due and shall be paid at the time specified, regardless of the final settlement for the building as a whole, or for the work of any other trade; and when the contract is with a general contractor the payment for steel shall not be delayed by such general contractor pending his receiving estimates of payments from the owner.

7. Amounts past due shall bear interest at the maximum lawful rate.

## STANDARD FORM OF PROPOSAL

The Seller for the consideration of.....
hereby agrees to furnish all the materials and to perform all of the labor in accordance with the conditions of the Code of Standard Practice of the American Institute of Steel Construction dated October 1st, 1924, for furnishing and erecting the.....
.....
for.....
located at.....
as shown on the drawings.....
and as mentioned in the specifications for.....
pages.....

Terms of payment shall be in accordance with the above mentioned Code of practice, except as follows.....
.....

The Seller further agrees to furnish such material and complete such labor within the following time.....
.....

The Buyer shall furnish complete information within.....
days to enable the Seller to complete all necessary shop drawings.

Extra materials and labor furnished by the Seller shall be invoiced to the Buyer at their full cost plus a profit of.....
per cent.

Inasmuch as materials are subject to prior sale, this proposal is made for acceptance on or before.....and the price is subject to change without notice.

Accepted By:

.....

.....

Herein designated as the Buyer
or his authorized agent

Date of Acceptance:

.....

Witnessed By:

.....

SIGNED BY

.....

.....

Herein designated as Seller

.....

Date.....

*REALIZING that the existing empirical methods of considering fire hazards and fire protection have been unsatisfactory to the construction industries, the American Institute of Steel Construction, Inc., asked a committee of prominent engineers to undertake the preparation of a Specification that would deal with these questions from a rational standpoint.*

*The resulting specification, we believe, constitutes a most important development to the construction industry.*

*The personnel of this committee is as follows:*

**H. G. BALCOM—**

Mem. American Society of Civil Engineers
Mem. American Society for Testing Materials
Consulting Engineer, New York City

**FRANK BURTON—Chairman of Committee**

Past President, Building Officials Conference
Past President, Detroit Engineering Society
Mem. American Chemical Society
Consulting Engineer, Detroit, Mich.

**A. R. ELLIS—**

Mem. American Society for Testing Materials
Mem. American Society of Municipal Engineers
Mem. American Welding Society
Mem. Engineers Society of Western Pennsylvania
Mem. National Electric Light Association
General Manager, Pittsburgh Testing Laboratory, Pittsburgh, Pa.

**S. H. INGBERG—**

Mem. Western Society of Engineers
Mem. American Society for Testing Materials
Mem. American Concrete Institute
Mem. National Fire Protection Association
Assoc. Mem. Building Officials Conference
Senior Engineer, United States Bureau of Standards

**RUDOLPH P. MILLER—**

Mem. American Institute of Consulting Engineers
Mem. American Society of Civil Engineers
Mem. American Society for Testing Materials
Past President, Building Officials Conference
Past President, National Fire Protection Association
Mem. United States Department of Commerce Building Code Committee
Consulting Engineer, New York City

**F. E. TURNEAURE—C. E., D. Eng.**

Mem. American Association for Advancement of Science
Mem. Western Society of Engineers
Mem. American Railway Engineering Association
Mem. American Society of Civil Engineers
Mem. Society for Promotion of Engineering Education
Dean, College of Mechanics & Engineering, University of Wisconsin, Madison, Wis.

# STANDARD SPECIFICATION FOR FIRE-PROOFING STRUCTURAL STEEL BUILDINGS

**October 8th, 1927**

## *Foreword*

The Specification of the American Engineering Standards Committee for Fire Tests of Building Construction and Materials as published by the American Society for Testing Materials, serial designation C-19-26T, shall apply so far as it defines test procedure. The present specification provides an alternate method of defining the end point of the tests which is based on the maximum temperatures at which the structural steel is permitted to carry the stresses used in the design.

It is not intended that this specification will cover fire hazards that may occur during construction.

It is contemplated that the exterior and interior walls and the floor or roof slabs of the building will confine the fire to its place of origin without protection by automatic sprinklers or manual fire protection.

Such data regarding the fire resistance of structural steel members, and the insulating properties of materials, as have been derived in accordance with the specification C-19-26T, and that are found applicable to types of building members treated in this specification, may be used.

Data of this nature regarding columns were developed in a co-operative series of fire tests by The Associated Factory Mutual Laboratory, The Underwriters' Laboratories, and the Bureau of Standards, the results of which are given in the publication "Fire Tests of Building Columns," obtainable from the Underwriters' Laboratories, Chicago, Ill., or the Superintendent of Documents, Washington, D. C.

Since this specification deals with the question of fire protection from a relatively new standpoint, it has been considered advisable to incorporate some data that is informative, which if attached as notes or appendix might be overlooked.

# STANDARD SPECIFICATION FOR FIRE-PROOFING STRUCTURAL STEEL BUILDINGS

**October 8th, 1927**

## SECTION 1. PURPOSE AND SCOPE

The purpose and scope of this specification is:—

(a) To define basic conditions relative to the insulation necessary to protect structural steel when exposed to fire hazards, and thus enable engineers to design and classify steel structures for temperature resistance.

(b) To provide data that will enable the classification of fire hazards, and to rate them on the basis of their relative intensity and duration as compared to an established standard time-temperature hazard.

(c) To define the physical characteristics of structural steel within the temperature range that it is capable of carrying the working stresses used in designing, thus making possible the substitution of temperature determinations for the loading of test specimens during fire tests.

(d) To define fire test procedure that will give data on a uniform basis regarding the insulating properties of different fire resistive insulators.

## SECTION 2. FIRES

(a) The intensity and duration of fires is variable, but for the purpose of this specification all fires shall be classified, with regard to their intensity and duration, on the basis of the average time-temperature definitions as set forth in the tentative specification for fire tests on building construction and materials as prepared by the sectional committee on Fire Test Specifications under the joint sponsorship of the United States Bureau of Standards, the American Engineering Standards Committee Fire Test Group, and the American Society for Testing Materials, in accordance with the procedure of the American Engineering Standards Committee, and published by the American Society for Testing Materials under serial designation C-19-26T.

(b) The time-temperature definition of the above referred to specification is given by the accompanying table and shown by the curve in Fig. No. 1.

1000° F. at 5 minutes duration
1300° F. at 10 minutes duration
1550° F. at 30 minutes duration
1700° F. at 1 hour duration
1792° F. at 1 hour and 30 minutes duration
1850° F. at 2 hours duration
1925° F. at 3 hours duration
2000° F. at 4 hours duration
2075° F. at 5 hours duration
2150° F. at 6 hours duration
2225° F. at 7 hours duration
2300° F. at 8 hours duration

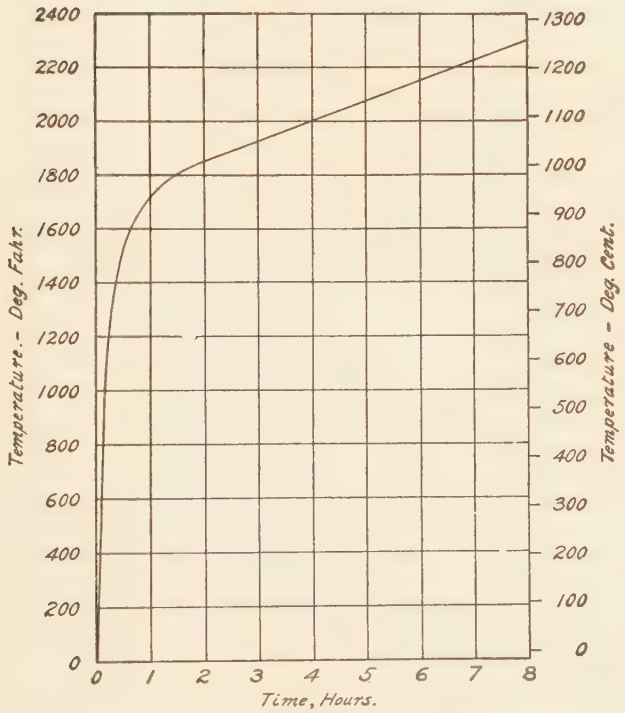



*Fig. I. Time Temperature Curve.*

(c) The temperature in the combustion chamber fixed by the curve shall be deemed the average obtained from the readings of several thermo-couples (not less than three) symmetrically located to show the temperature near all parts

of the specimen being tested, the thermo-couples being enclosed and sealed in standard porcelain tubes ¾ inch outside diameter, and with walls ⅛ inch thick. The exposed length of the thermo-couples and porcelain tubes shall extend not less than 12 inches into the combustion test chamber. Pyrometers or thermo-couple protecting tubes which are not standard may be used if under test conditions they give readings that are within the limits of accuracy that apply for furnace-temperature measurements. Other conditions defining the control of fire tests shall be as fixed by the above referred to specifications.

## SECTION 3. FIRE HAZARDS

(a) For the purpose of this specification fire hazards shall be classified in accordance with the nature and combustibility of the materials which the buildings contain.

(b) Fire resistive buildings shall be rated as to fire hazards due to interior fires on the basis of the temperature which their combustible contents will produce, and the time that is necessary to complete the burning of the combustible contents as compared to the standard time-temperature definition above given.

(c) The steel in the exterior walls of buildings shall be adequately protected against existing or probable maximum future exterior fire hazards.

(d) The occupancy rating of the fire hazards of fire resistive buildings or parts thereof, shall be based upon the quantity of combustible contents per square foot of floor, and the equivalent intensity of fire which the contents will produce as compared to the standard time-temperature curve.

(e) All fire resistive buildings, together with such parts as are used for the storage or handling of extra quantities of combustible materials, shall be fireproofed to protect them against maximum fire hazards within any section having fire separation from the remainder of the building, in accordance with the measured quantities of contained combustible materials including wood floor covering and wood trim. The burning out tests conducted by the Bureau of Standards with office occupancy and record storage, indicate the following equivalent fire hazard will approximately apply:

10 pounds per square foot constitutes a 1 hour fire hazard
15 pounds per square foot constitutes a 1½ hour fire hazard
20 pounds per square foot constitutes a 2 hour fire hazard
30 pounds per square foot constitutes a 3 hour fire hazard
40 pounds per square foot constitutes a 4½ hour fire hazard
50 pounds per square foot constitutes a 6 hour fire hazard
60 pounds per square foot constitutes a 7½ hour fire hazard

The maximum fire hazard based on the weight of combustible materials shall be determined from the floor area of any one bay of the building or fire division thereof.

The above classification when applied to office equipment is based upon the use of wood furniture and shelving. Other burning out tests of offices equipped with metal furniture and shelving, and with papers exposed by opened drawers, show a very substantial reduction of the fire hazard.

The combustible contents of some fire resistive buildings may weigh less than 10 pounds per square foot of floor, but for the purpose of this specification no building shall be considered fire resistive that is not constructed to resist a fire of at least one hour standard duration with the pertaining safety factor.

## SECTION 4. STEEL

(a) The occasion for fireproofing structural steel is to insulate it against a rise of temperature that would seriously impair its ability to sustain the loads at the unit stresses used in the design.

(b) This specification applies only to steel of the quality defined by the A. S. T. M. Standard Specification for Structural Steel for Buildings.

(c) The maximum working stresses for structural steel shall be those fixed by the Standard Specification for Structural Steel for Buildings of the American Institute of Steel Construction, dated June 1st, 1923.

(d) Under the conditions of this specification the structural steel shall carry the entire load, except that beams, girders, or trusses, may have wall bearing supports, and no stress shall be assumed as carried by the fireproofing materials, when subjected to a fire. In cases where the original design considers a part of the compression stresses as carried by some of the material used for fireproofing, a corresponding percentage of the stress may be considered as carried by the fireproofing material during a fire.

(e) In steel frame buildings or in buildings with part wall bearing, the skeleton frame shall be considered as the columns, and the girders, beams, trusses and spandrels having direct connections to the column. The secondary members of floor or roof panels are those which have no direct connections to the columns of the building. Supplementary steel members shall be those members used in connection with openings in outside wall or interior partitions, and which do not transmit the loads which they may carry through direct connections to the skeleton frame or secondary members. Masonry bearing lintels spanning openings greater than six feet shall be considered secondary members.

(f) The strength of structural steel at approximately 550° F. is about 25% greater than its normal temperature strength, and at 800° F. its strength is approximately the same as its normal temperature strength.

At a temperature of 1000° F. the compression strength of steel is approximately the same as the maximum permissible working stress in columns, and under a rare hazard of fire it shall be permissible for insulated steel columns to carry their working stresses when the average temperature at any critical cross

section does not exceed 1000° F., or when the maximum temperature at the critical cross section does not exceed 1200° F.

If the maximum working stress in tension or compression is 18,000 pounds per square inch in any member or critical flange of a member resisting bending moments, it shall be permissible for the member to carry its maximum working stress if the average temperature does not exceed 1000° F., or the maximum does not exceed 1200° F. at any cross section of the member, or its critical flange. If higher working stresses are used, proper consideration shall be given to extra insulation against temperature.

(g) If structural steel of special manufacture is used at higher working stresses than those fixed by this specification, its strength as compared to the steel of this specification at high temperatures shall be determined, and it shall be insulated against a rise of temperature that will leave its strength proportionately above the working stress.

(h) The average coefficient of expansion for structural steel between the temperatures of 200° F. and 1100° F. is given by the formula

$$C = .0000061 + .0000000022\,t$$

in which C is the coefficient of expansion for each degree F., and $t$ is the temperature Fahr.

From 1100° F. to 1400° F. there is a slight variation in the coefficient, and below 200° F. the variation is less than that at the higher temperatures.

(i) Structural steel maintained at various constant temperatures has a uniform coefficient of elasticity up to the elastic limit stress, but between the elastic limit stress and the yield point stress, the rate of deformation with stress is a variable. If a member is subject to bending which produces stresses in the extreme fibre above the elastic limit it results in the extreme fiber and a portion of the adjacent fibers nearer the neutral axis carrying approximately the same stresses, and accounts for yield points determined by flexure being sometimes considerably higher than yield points determined by axial tension.

The coefficient of elasticity of steel decreases as the temperature increases, and the initial or tangent coefficient of elasticity for temperatures between 200° F. and 1300° F. is given approximately by the formula

$$E = 32400000 - 17000\,t$$

in which E is the initial or tangent coefficient of elasticity, and $t$ is the temperature Fahr. Between room temperature and 200° F. there is a smaller variation in E.

The formula $E = 32400000 - 17000\ t$ does not apply for stresses above the elastic or proportional limit which varies with the temperature approximately as follows:

200° F. Elastic Limit = 33000 # per sq. inch
300° F. Elastic Limit = 28000 # per sq. inch
500° F. Elastic Limit = 16000 # per sq. inch
700° F. Elastic Limit = 12000 # per sq. inch
900° F. Elastic Limit = 8000 # per sq. inch
1100° F. Elastic Limit = 5000 # per sq. inch
1300° F. Elastic Limit = 2000 # per sq. inch

## SECTION 5. FIREPROOFING MATERIALS

(a) The insulating material used shall be so applied that the difference in temperature of the steel in any cross section shall not set up serious internal or buckling stresses, and so that such variation as exists will be symmetrical about the axes of compression members.

(b) Fire resisting insulating material shall continue to function within the temperature range of its use, and shall be so applied that it will not crack, spall, or buckle to seriously expose the steel to direct heat from fire.

(c) If the insulating of columns contemplates the use of air spaces between the steel and the insulator, there shall be fire stops placed at the floor levels.

## SECTION 6. TESTS

(a) In lieu of the test procedure described in C-19-26T the following procedure may be employed in the preparation of data regarding the fire resistive properties of insulating materials that are used under the conditions of this specification.

(b) If the insulation contemplates the use of air spaces between the steel and the insulator, the ends of the test specimen shall be thoroughly fire-stopped to prevent the escape of heat from the air spaces.

(c) Temperature reading of all thermo-couples both in the combustion chamber and on the steel shall be made every five minutes during the first hour of the test, but may be read at 15 minute intervals thereafter.

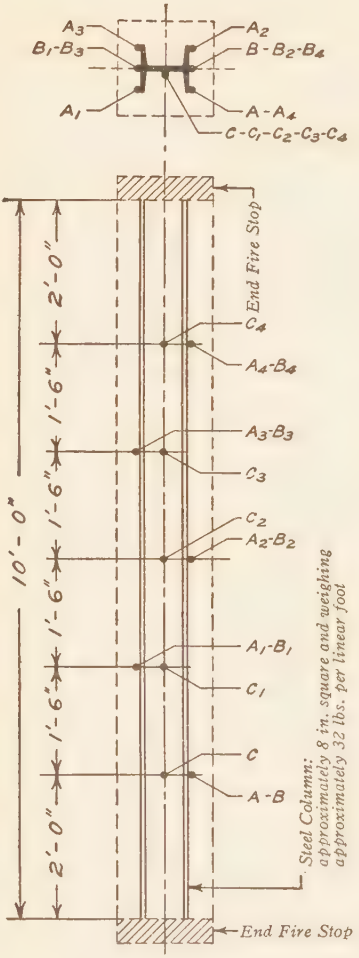



*Fig. 2 Column Fireproofing Test*

(d) Test specimens for columns shall consist of a rolled steel H section 10 feet long with not less than 15 thermo-couples arranged as shown in figure #2. The steel H section shall be approximately 8″ square and weigh approximately 32 pounds per linear foot. The thermo-couples A, B, C — $A_1$, $B_1$, $C_1$, — $A_2$, $B_2$, $C_2$, — $A_3$, $B_3$, $C_3$, — $A_4$, $B_4$, $C_4$, shall be placed against or in the steel in the positions shown to give the temperature of the steel whether the fireproofing is solid or includes an air space. Column tests shall be conducted with the test specimen in a vertical position. The average temperature of the steel at different cross sections as found by the readings of thermo-couples A, B, C, — $A_1$, $B_1$, $C_1$, etc., shall not exceed 1000° F., and the maximum reading for any thermo-couple shall not exceed 1200° F. The average temperature of the steel as found for any cross section by the reading of A, B, C, — $A_1$, $B_1$, $C_1$, etc., will be obtained for this test specimen by the following formula:

Average = .39 × A (reading) + .5 × B (reading) + .11 × C (reading)

Example: If A reading is 1200° F., B reading is 1100° F., and C reading is 1000° F., the average for the area is .39 × 1200 + .5 × 1100 + .11 × 1000 = 1128° F.

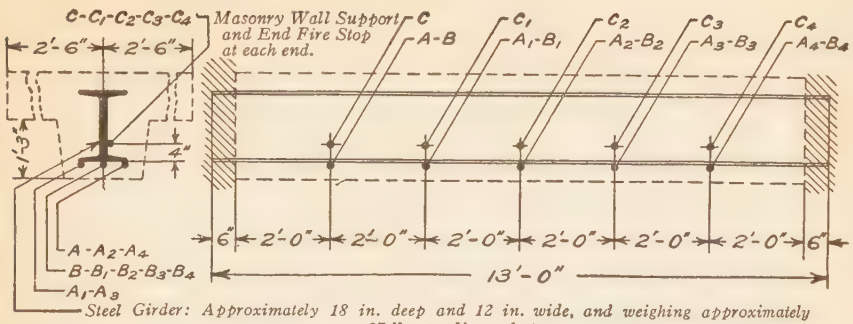



*Fig. 3. Girder Fireproofing Test for Paneled Ceiling*

(e) The test specimen for girders in paneled ceiling construction shall consist of a rolled steel girder 13 feet long with not less than 15 thermo-couples arranged as shown in Fig. No. 3. The steel girder section shall be approximately 18″ deep with a flange approximately 12″ wide and weigh approximately 87 pounds per linear foot. The panel projection below the ceiling shall be about 1′–3″, and the thermo-couples A,B,C, — $A_1$, $B_1$, $C_1$, etc., shall be placed against or in the steel in the position shown to give the temperature of the steel whether the fireproofing is solid or includes an air space. The specimen shall be tested in a horizontal position. The average temperature of the steel of the flange as found from the readings of thermo-couples A,B,C, — $A_1$, $B_1$, $C_1$, — $A_2$, $B_2$, $C_2$, etc., shall not exceed 1000° F., and the maximum reading for any thermo-couple shall not exceed 1200° F. The average temperature of the steel of any flange cross section as found from the reading of A, B, C, —$A_1$, $B_1$, $C_1$, etc., will be obtained for this test specimen by the following formula:

$$\text{Average} = .43 \times \text{A (reading)} + .5 \times \text{B (reading)} + .07 \times \text{C (reading)}$$

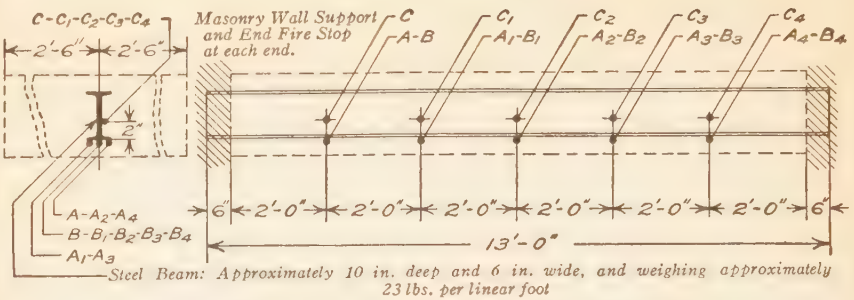



*Fig. 4. Beam Fireproofing Test for Flush Ceiling*

(f) The test specimen for flush ceiling floor construction shall consist of a rolled steel beam 13 feet long with not less than 15 thermo-couples arranged as shown in Fig. No. 4. The steel beam shall be approximately 10″ deep with a flange approximately 5¾″ or 6″ wide, and shall weigh approximately 23 pounds per linear foot. The thermo-couples A,B,C, — $A_1$, $B_1$, $C_1$, etc., shall be placed against or in the steel in the position shown to give the temperature of the steel whether the fireproofing is solid or includes an air space. The specimen shall be tested in a horizontal position. The average temperature of the steel of the flange as found from the readings of thermo-couples A,B,C, — $A_1$, $B_1$, $C_1$, etc., shall not exceed 1000° F., and the maximum reading for any thermo-couple shall not exceed 1200° F. The average temperature of the steel of any flange cross section as found from the reading of A, B, C, — $A_1$, $B_1$, $C_1$, etc., will be obtained for this test specimen by the following formula:

$$\text{Average} = .43 \times \text{A (reading)} + .5 \times \text{B (reading)} + .07 \times \text{C (reading)}$$

## SECTION 7. SAFETY FACTOR

(a) Steel buildings whose condition of exterior exposure and whose contents under fire hazards will not produce a temperature greater than 800° F. in the steel, shall be considered fire resistive without insulating protection for the steel.

(b) If the steel work has an insulating protection, the safety factor shall be based on the fireproofing material providing protection for a greater period of time than the combustible contents of the building will burn as shown in Section 3, Par. e. of this specification. The safety factor for all skeleton frame and secondary members shall be 1½. For example: if a building contains 10 pounds of combustible material per square foot of floor, and has a fire hazard of one hour duration, the steel work shall be protected against the temperatures defined in this specification for 1½ hours

Supplementary members shall not require insulating protection.

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*The following tabulated data is not a part of the fireproofing specification but is given here to aid the engineer in a fuller understanding of the conditions relating to the subject. It has been compiled from a careful study of all the available literature that has appeared since about 1890 and is in substantial agreement with the research findings of Dr. Albert Sauveur, who is the Gordon McKay Professor of Metallurgy and Metallography of Harvard University.*

*The tangent elastic limit is the stress per square inch at which the stress-strain curve ceases to be a straight line. It will be noted that at high temperatures the spread between the tangent elastic limit and the yield point is greater than at normal temperatures.*

| Temp. Fahr. | Ultimate Strength in Pounds per Sq. In. | Yield Point in Pounds per Sq. In. | Tangent Elastic Limit in Pounds per Sq. In. | Modulus of Elasticity Below Tangent Elastic Limit | Per Cent of Elongation | Per Cent of Reduction of Area |
|---|---|---|---|---|---|---|
| 100 | 54000 | 39000 | 36000 | 30 700 000 | 48 | 68 |
| 200 | 56000 | 43000 | 33000 | 29 000 000 | 43 | 66 |
| 300 | 58000 | 46000 | 28000 | 27 300 000 | 39 | 65 |
| 400 | 60000 | 47000 | 22000 | 25 600 000 | 37 | 64 |
| 500 | 63000 | 46000 | 16000 | 23 900 000 | 37 | 64 |
| 600 | 66000 | 44000 | 14000 | 22 200 000 | 40 | 66 |
| 700 | 60000 | 40000 | 12000 | 20 500 000 | 44 | 68 |
| 800 | 52000 | 37000 | 10000 | 18 800 000 | 49 | 76 |
| 900 | 43000 | 32000 | 8000 | 17 100 000 | 55 | 84 |
| 1000 | 34000 | 27000 | 7500 | 15 400 000 | 60 | 90 |
| 1100 | 25000 | 21000 | 5000 | 13 700 000 | 64 | 94 |
| 1200 | 19000 | 17000 | 3500 | 12 000 000 | 68 | 96 |
| 1300 | 14000 | 13000 | 2000 | 10 300 000 | 72 | 98 |

# MINIMUM LIVE LOADS ALLOWABLE FOR USE IN THE DESIGN OF BUILDINGS

**As recommended by the**
**Building Code Committee of the Bureau of Standards,**
**United States Department of Commerce**

## 1. Definitions.

1. *Dead Load.*—The dead load in a building includes the weight of walls, permanent partitions, framing, floors, roofs, and all other permanent stationary construction entering into a building.

2. *Live Load.*—The live load includes all loads except dead loads.

## 2. General.

Buildings and all parts thereof shall be of sufficient strength to support safely their imposed loads, live and dead, in addition to their own proper dead load; provided, however, that no building or part of a building shall be designed for live loads less than those specified in the following sections.

## 3. Human Occupancy.

1. For rooms of private dwellings, hospital rooms and wards, guest rooms in hotels, lodging and tenement houses, and for similar occupancies, the minimum live load shall be taken as 40 pounds per square foot uniformly distributed, except that where floors of one and two family dwellings are of monolithic type or of solid or ribbed slabs the live load may be taken as 30 pounds per square foot.

2. For floors for office purposes and for rooms with fixed seats, as in churches, school classrooms, reading rooms, museums, art galleries, and theaters, the minimum live load shall be taken as 50 pounds per square foot uniformly distributed. Provision shall be made, however, in designing office floors for a load of 2,000 pounds placed upon any space 2½ feet square wherever this load upon an otherwise unloaded floor would produce stresses greater than the 50-pound distributed load.

3. For aisles, corridors, lobbies, public spaces in hotels and public buildings, banquet rooms, assembly halls without fixed seats, grandstands, theater stages, gymnasiums, stairways, fire escapes or exit passageways, and other spaces where crowds of people are likely to assemble, the minimum live load shall be taken as 100 pounds per square foot uniformly distributed. This requirement shall not apply, however, to such spaces in private dwellings, for which the minimum live load shall be taken as in paragraph 1 of this section.

## 4. Industrial or Commercial Occupancy.

In designing floors used for industrial or commercial purposes, or purposes other than previously mentioned, the live load shall be assumed as the maximum caused by the use which the building or part of the building is to serve. The following loads shall be taken as the minimum live loads permissible for the occupancies listed, and loads at least equal shall be assumed for uses similar in nature to those listed in this section.

| Floors used for: | Minimum Live Load in lbs. per sq. ft. |
|---|---|
| Storage purposes (general) | 250 |
| Storage purposes (special) | 100 |
| Manufacturing (light) | 75 |
| Printing plants | 100 |
| Wholesale stores (light merchandise) | 100 |
| Retail salesrooms (light merchandise) | 75 |
| Stables | 75 |
| Garages | |
| All types of vehicles | 100 |
| Passenger cars only | 80 |
| Sidewalks—250 or 800 pounds concentrated, which ever gives the largest moment or shear. | |

### 5. Roof Loads.

Roofs having a rise of 4 inches or less per foot of horizontal projection shall be proportioned for a vertical live load of 30 pounds per square foot of horizontal projection applied to any or all slopes. With a rise of more than 4 inches and not more than 12 inches per foot a vertical live load of 20 pounds on the horizontal projection shall be assumed. If the rise exceeds 12 inches per foot no vertical live load need be assumed, but provision shall be made for a wind force acting normal to the roof surface (on one slope at a time) of 20 pounds per square foot of such surface.

### 6. Allowance for Movable Partition Loads.

Floors in office and public buildings and in other buildings subject to shifting of partitions without reference to arrangement of floor beams or girders shall be designed to support, in addition to other loads, a single partition of the type used in the building, placed in any possible position.

### 7. Reductions in Live Loads.

Except in buildings for storage purposes the following reductions in assumed total floor live loads are permissible in designing all columns, piers or walls, foundations, trusses, and girders.

| *Reduction of total live loads carried* | Per cent |
|---|---|
| Carrying one floor | 0 |
| Carrying two floors | 10 |
| Carrying three floors | 20 |
| Carrying four floors | 30 |
| Carrying five floors | 40 |
| Carrying six floors | 45 |
| Carrying seven or more floors | 50 |

For determining the area of footings the full dead loads plus the live loads, with reductions figured as permitted above, shall be taken; except that in buildings for human occupancy, listed in section 3, a further reduction of one-half the live load as permitted above may be used.

# *The Historical Development*

*of*

# STEEL

*and*

# IRON

The two words, Steel and Iron, have been used so extensively to indicate the same thing that it is uncertain what should be the proper distinction between the two materials. However, the popular conception is that steel means a more refined state than the word iron.

Under modern conditions of production, the first state of iron after refinement from the ore is usually known as cast iron, and a continued refinement of cast iron is usually called steel; and it is the popular conception that a further refinement of the steel produces wrought iron. As a matter of fact, in the early production wrought iron was developed directly from the ore in a plastic condition and it was only after many centuries that the iron could be produced from the ore in a molten condition, which permitted it being poured into molds to form castings.

Next to oxygen, silicon and aluminum, iron is the most widely distributed and largest part of the solid material in the earth, and is about 4⅞% of the solid earth crust.

For many years steel has been considered the index of the commercial activities of the country, but in a broader sense, it has from the beginning of history, been an accurate measure of the progress of civilization since it is the medium through which all of our attainments are possible, and without it we must have continued in a savage state. It is the only substance that

can be hardened to form the tools by which all of our necessities are made, including wood work, machinery, transportation, in all forms, agricultural implements, steam engines, and since it alone possesses magnetic properties, all our electrical devices and developments depend upon it.

It is doubtful whether iron was known when the pyramids were made some 6000 years ago, but it was used by the Hebrews, Assyrians, Phoenicians, Greeks, and by the Romans, who found it being used by the Britains at the time of Caesar's invasion. Through all of this time, and up to about 1400 A. D. iron was produced in very small quantities, and in a shallow saucer shaped forge in which the ore and charcoal were mixed and from which the iron was thus separated. It would therefore seem natural that up to this time iron would be used largely for weapons of combat and for small tools.

About 1400 A. D. the first masonry furnace resembling the principles of the modern blast furnace was made in Europe, and about one hundred years later, it was introduced into England. Previous to this all of the refining was accomplished by hand puddling, and forging, and it was only after the furnace method was developed, that quantities could be made large enough to use for castings. In fact it was impossible up to this time to develop temperatures that would melt the material.

Following this and for nearly three hundred and fifty years the methods of refinement were limited to puddling in a small reverberatory furnace from which the product was removed, as a puddle ball, and subjected to forging. The next outstanding accomplishment was the Bessemer converter developed between 1850 and 1860 in England by Henry Bessemer, and in America by William Kelly of Eddyville, Ky. Bessemer's financial strength enabled him to absorb his American contemporary and the process has since born his name. Briefly, the Bessemer process consists in passing air through a melted cast iron which contains combustible impurities in such quantities that chemical reaction is generated to raise the temperature to such a point that undesirable impurities are removed from the molten mass. This process is accomplished in about fifteen minutes, but its application is limited to iron which contains combustible materials in quantities that make the process workable.

While Bessemer was developing his converter, William Seimens was working on the open hearth process, and built the first gas burning furnace of this type in 1861. The success of the Bessemer even with its limitations as fixed by the nature of the ores required, and the resulting product, established that an almost unlimited market existed for an economically produced steel. This resulted in the vigorous development of the open hearth which was not so restricted as to the materials used, and while the process is longer than the Bessemer, the product is more uniform in chemical and physical properties, and soon outstripped its rival for public favor. Both processes made possible the casting of large ingots from which various shapes could be rolled, and by 1892 had practically eliminated sections of wrought iron which had to be made by welding small bars together through a re-

rolling process such as is still used for stay bolt iron and chain iron. As the development of steel progressed, the sky line of our cities changed rapidly. The electric furnace is following the open hearth and is capable of producing a material of almost any preconceived chemical analysis, but so far at a cost that prevents its entering into competition with the Bessemer or the open hearth for ordinary structural grade steel. The remarkable precision of chemical and physical properties that are uniformly attained by these processes is unknown to any other industry, and is illustrated by the fact that the chemical properties are expressed in hundredths of a per cent, and it is doubtful whether drops from a medicine dropper used in filling prescriptions are closer than 5% of each other. Throughout all of the processes of treating the ore and finishing through the Bessemer, the open hearth, or the electric furnace, great care is used in the selection of the fluxes, and the furnace linings by means of which the chemical properties of the material are determined.

In all of these processes, the method of refining involves the treatment of molten material, but it has been found commercially practicable to refine certain grades of cast iron, and change it from a crystalline to a malleable structure without heating it to the melting point.

Remaur in 1722 described the production of ductile castings by processes which removed the carbon from white grey iron by heating it in an oxide. This process is still used in Europe but in America it has been supplanted by the Boyden process, which was introduced in 1826. The Boyden process results in what is called malleable cast iron, which resembles the ordinary grey cast iron, only in that both are cast in molds.

Grey iron castings contain about 2½% graphite, which exists as flat flakes of free carbon and gives the fractured material a granular appearance. By subjecting certain grades of grey iron castings for about three days to a temperature of approximately 1300° F. but not higher than 1700° F. a part of the carbon is removed, and the remaining graphite flakes are converted into small carbon nodules which are scattered throughout the material. This results in a dead soft malleable iron.

Malleable cast iron (A. S. T. M. Specifications) is required to have a tensile strength, as measured in a test specimen of prescribed form, of 50,000 lbs. per square inch, and a minimum elongation of 10%. The point at which a test specimen of malleable iron will elongate about .01" in 2" is sometimes spoken of as the yield point, which is about 35,000 lbs. per square inch. The shearing strength is about 45,000 lbs. per square inch.

The material flows under compression at stresses above the yield point, and its ultimate strength by fracture in compression is therefore not determinable. The coefficient of elasticity or Young's modulus in tension or compression is about 25,000,000.

The following table is reproduced from a volume entitled "The Making, Shaping and Treating of Steel,"* and illustrates the approximate chemical properties which distinguishes pig iron, plain steel, and wrought iron.

## Chemical Relations of Pig Iron, Wrought Iron and Plain Steel

| | PER CENT. OF | | | | | |
|---|---|---|---|---|---|---|
| Name | Iron | Carbon | Manganese | Sulphur | Phosphorus | Silicon |
| Pig Iron | 91 —94 | 3.50—4.50 | .50—2.50 | .018—.100 | .030—1.00 | .25—3.50 |
| Plain Steel | 98.1—99.5 | .07—1.30 | .30—1.00 (.03—.10 as cast) | .020—.060 (.120) | .002—.100 | .005— .50 |
| Wrought Iron | 99.0—99.8 | .05— .25 | .01— .10 | .020—.100 | .050— .20 | .02— .20 |

** Note.—"The making, shaping and treating of steel" is published by the Carnegie Steel Co. and should be read by every person interested in steel. It can be obtained from the Bureau of Instructions of the Carnegie Steel Co. at Pittsburgh, Pa. Price $7.50.*

## Physical Properties of Steel and Iron

### IRON

Pure iron is almost unknown commercially. It is a grayish white color and soft compared with carbon steel. It is malleable, ductile, and magnetic. It is 7.78 times heavier than water, and in its commercial forms melts at about 1520°C. or about 2770°F.

The presence of the various elements which are combined with iron in its commercial forms lowers this melting point very rapidly. The ultimate strength is approximately 38,000 pounds per square inch and the elastic limit about 20,000 pounds per square inch.

### STRUCTURAL STEEL

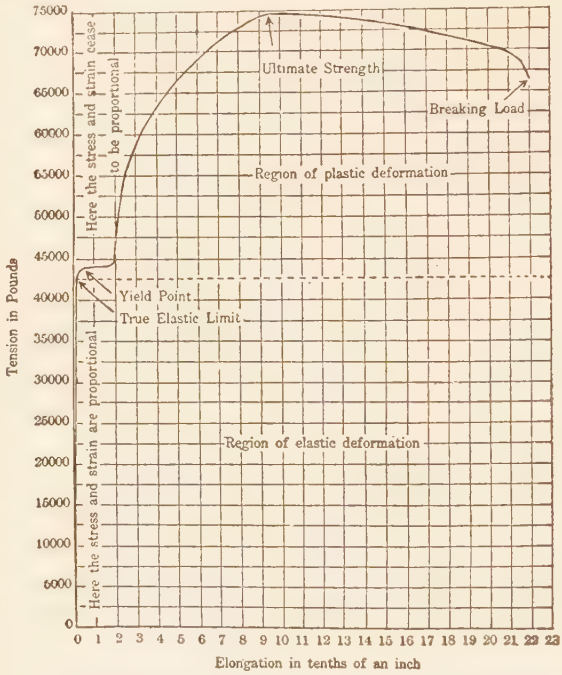
Structural steel weighs .2833 pounds per cubic inch or 490 pounds per cubic foot. It is therefore about 7.85 times heavier than water.

### ELASTICITY

Structural steel is perfectly elastic below the stress per square inch which is called the yield point, and beyond this yield point there will be permanent set or deformation when the load is removed. Just below the yield point, and usually within 1000 pounds per square inch of it is the elastic limit, below which the elongation or deformation is always exactly proportional to the stress per square inch. The ratio of elongation to the stress per square inch is called the coefficient of elasticity, the modulus of elasticity, or sometimes Young's Modulus. It may otherwise be defined as that stress per square inch, which in tension would double the length of a test specimen assuming that uniform elasticity were possible throughout the experiment. For structural grades of steel, the coefficient of elasticity is 29,000,000 pounds; that is, a bar 1 square inch in area will stretch one twenty-nine millionth (1/29,000,000) of an inch for each inch of length and for each pound of stress. It has been found by innumerable experiments that the physical properties of steel cannot be changed regardless of the number of times a load may be applied to it so long as the stresses produced do not exceed the elastic limit. It has also been found that when steel is loaded to produce stresses beyond its yield point, and therefore producing permanent set, that the material will have a higher elastic limit and yield point if the original stresses are

removed. It is this principle that is used in the manufacture of cold rolled, or cold drawn steel.

The following diagram is reproduced from "The Making, Shaping, and Treating of Steel," and graphically illustrates the performance of the material within the various ranges of its strength.




The chart represents a specimen whose dimensions before pulling were as follows:

Length.....8″

Width.....1.41″

Thickness...86″

Area in sq. in.1.213

The elastic limit per square inch was 36770 lbs.

The ultimate strength per square inch was 61500 lbs.

The elongation in 8″ was 27.5%.

The reduction in area was 50.5%.

Fig. 46. Graph Representing the Pulling of a Structural Steel Test Piece.

The elastic limit and ultimate strength of steel depend not only upon the chemical composition of the material, but also upon the amount of work done on the material in producing it, and the temperature at which the work is finished. While there may exist among engineers a division of opinion as to the importance of the percentage of elongation and the reduction of area, there is no difference regarding the importance of the elastic limit and the ultimate strength.

The effect of carbon on the ultimate strength and elastic limit is to increase them, but at the same time it also results in a harder steel, and for that reason in ordinary structural grades it is usually below .25%. Manganese also has the effect of increasing the elastic limit and ultimate strength, but not to the extent produced by carbon. In large quantities it has the effect of producing a material very difficult to manufacture. One of the important effects of manganese, however, is that it neutralizes the evil effects of sulphur. Sulphur up to 0.1% has little or no influence on the ductility or strength of steel at ordinary temperatures. It does, however, have the effect of producing what is known as the red short conditions which means that the material is difficult to work at a red heat.

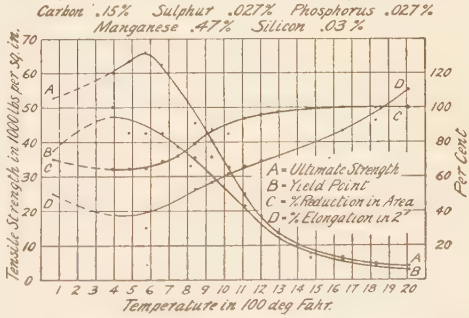
Phosphorus for many years has been considered responsible for steel at ordinary temperatures being brittle or technically termed, cold short, but it is doubtful whether quantities less than .1% have any very marked influence. It does increase the hardness and the tensile strength of the steel and reduces the ductility. Some experimenters have found that the evils produced by phosphorus are not the same, and have found that under apparently similar conditions the effect is entirely different, which indicates that it should be considered as a treacherous element. Some users refuse to accept steel which contains a higher percentage than .04%.

Silicon is now considered beneficial up to .75%, and up to this point it increases the elastic limit and the ultimate strength of the material without interfering with its ductility.

## The Effect of Temperature on Structural Steel

Steel in a liquid form is melted iron which contains carbon and other elements in solution. The percentage of carbon has an important effect on the physical properties of the steel when it reaches normal temperatures. For tool steels the amount of carbon is sometimes as high as 1.50%, but for structural grades of steel the percentage is usually below .25%, which is sufficient to have important bearing on the properties. As the steel changes from liquid to solid, and as the solid cools, there is a tendency for the carbon to segregate from the solution. The extent to which this segregation takes place depends to some extent upon the rapidity with which the cooling process takes place.

In the manufacture of structural steel the temperature conditions of cooling through the soaking pit process are carefully controlled so as to produce a fine uniform structure. It has been found that a fine grained structure in the steel has greater strength and more desirable physical properties than a structure which is coarse and granular. The carbon in structural steel at normal temperatures is almost completely in solution, and is visible under the microscope only as small dots.


Physical Properties of Steel at High Temperatures.
Carbon .15% Sulphur .027% Phosphorus .027%
Manganese .47% Silicon .03%
Tensile Strength in 1000 lbs per Sq. in.
Per Cent
A - Ultimate Strength
B - Yield Point
C - % Reduction in Area
D - % Elongation in 2"
Temperature in 100 deg Fahr.

This diagram is reproduced from the National Tube Company's Handbook of 1924, with the exception that the temperature readings are given on the Fahrenheit instead of the Centigrade scale.

The effect of temperature on the physical properties of steel is shown by the accompanying chart. These curves are based on tension tests of steel having about the same chemical analysis as structural steel. As the temperature is increased both the ultimate strength and the yield point increase until a temperature of 500° to 600° F. is reached, where both the ultimate strength and the yield point are approximately 25% above the normal temperature values. It will be

noted that at this range of temperature, the ductility of the steel, as represented by the percentage of reduction of area and percentage of elongation, decreases indicating a brittle range. At approximately 800° F. all of the physical properties are nearly the same as the normal temperature values, and at a temperature of approximately 1200° F., the yield point and the ultimate strength are almost the same, and the ultimate strength is about one-third of its normal temperature value. At a temperature of approximately 1350° F. there is what is known as the critical temperature.

The temperature and color chart reproduced from the Standard Handbook of Steel Construction shows the relation between temperature and color of steel, and summarizes the effect of temperature on steel.

Above 2100° F. the color is white, but as it cools it darkens in color and gradually decreases in volume by shrinking. During this cooling process there are a few seconds of time at the critical temperature, in which the color becomes brighter, and expansion in volume takes place. Above this temperature steel has lost its magnetic properties, and below it it gradually recovers them. Apparently a molecular reconstruction takes place accompanied by the absorption or release of heat, depending upon whether the temperature is ascending or descending through the critical temperature. At both the critical temperature and the temperature of maximum strength (near 600° F.) there takes place some rearrangement of the internal structure of the material, and during such rearrangement it may be reasonable to assume that stresses caused by shrinking should be very materially relieved.

As steel reaches the temperature of white heat, that is about 2100° F., the carbon is forced out of solution and segregated into flakes resembling those seen in the fracture of cast iron. This condition is sometimes described as burned steel, but in reality it is merely a segregation of the carbon from its condition of solution into one of intergranular flakes, which materially reduces the effective section of the steel and weakens it. It is, of course, possible by a proper annealing process, to reconstruct overheated steel, but the process requires considerable time and it is doubtful whether it should be undertaken without the supervision of experienced men.

It is therefore important that proper precautions be taken to prevent overheating either in the manufacture of rivets or in the heating of them for driving.

The above discussion leads to the following practical suggestions. Careful observation of these suggestions in the fabrication and erection of structural steel is highly important and will eliminate a great amount of trouble.

**Rivets should be subjected to a soaking heat, and their temperature before driving should not exceed 1950° F., which is a light yellow color.**

**A pneumatic or vibrating rivet gun should not be used on rivets after the temperature is below 1000° F., which is a blood red color. Below this temperature is the brittle range, and vibrating impact will loosen the rivet instead of tightening it.**

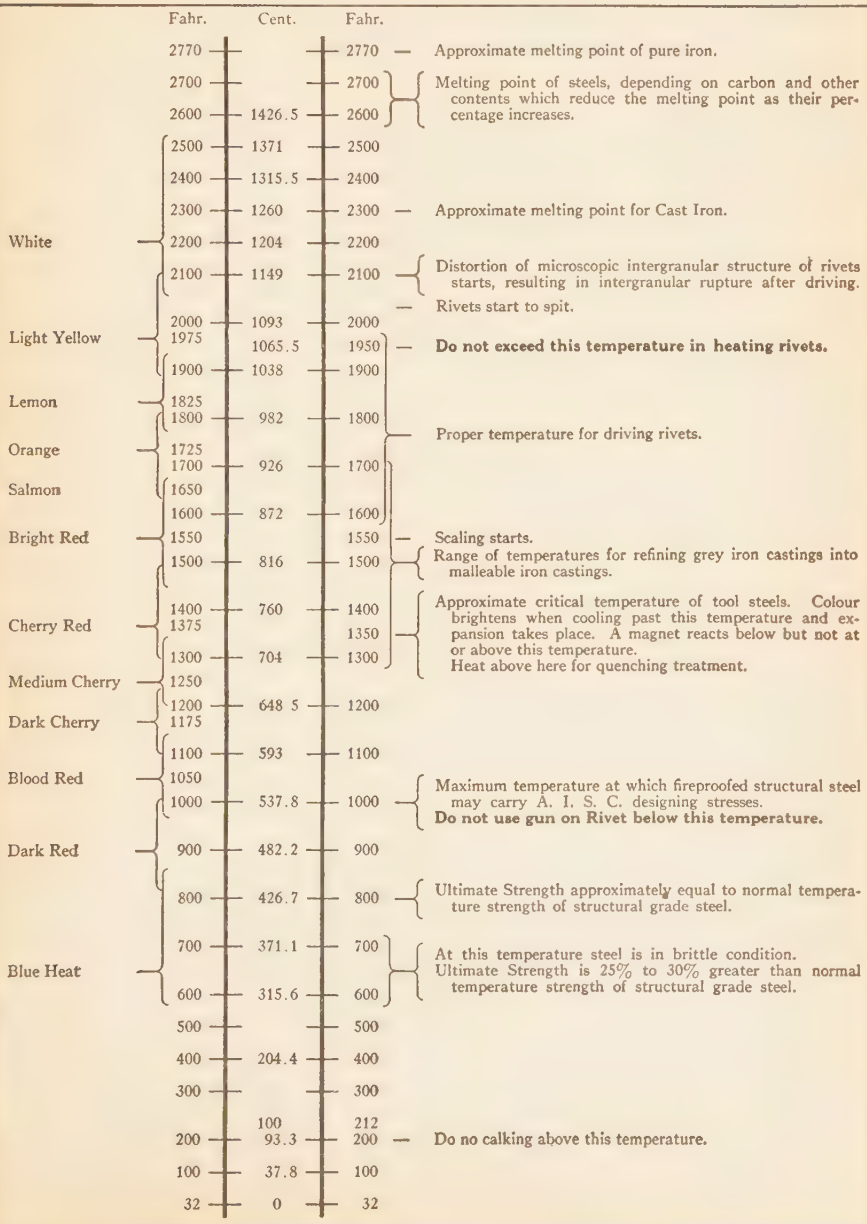
**Do not use a flame cutting torch on steel which is carrying stresses.**

**Caulking should not be done until the temperature is below 200° F.**

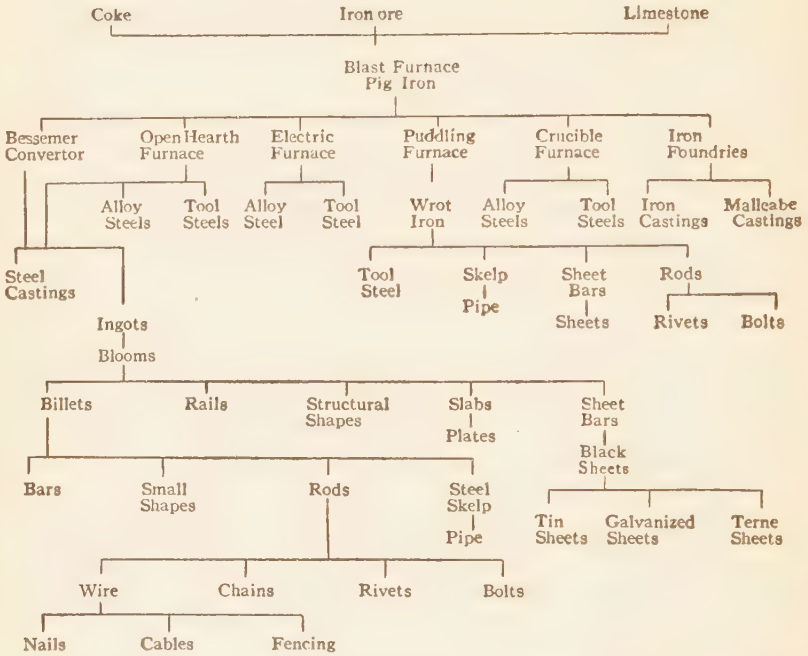
# TEMPERATURE CHART

**Working Temperature and Colour Chart for Iron and Steel**

Conversion Formulae $F° = \frac{9}{5}\ C + 32°$ $C° = \frac{5}{9}\ (F - 32°)$



## Chart showing the sequence of manufacture of steel and iron products




In connection with the above chart showing the sequence of manufacture, it is practically impossible for a layman to appreciate the innumerable details and conditions that must be fulfilled in every process of manufacture. When however, it is understood that between the blast furnace producing the pig iron, and the rolling mill producing the structural shapes, there is a loss of production amounting to in many cases as much as 25 or 30%, the layman will understand to some degree what is involved when a special analysis of steel is required. It is also of interest to note that for every ton of finished rolled steel that is shipped from a steel plant approximately six tons of ore, fuel, fluxes, refractories, lubricants, etc. must be shipped into the mill. There is every reason to expect that the manufacturers of steel will continue to improve their metallurgical processes and increase the uniformity of the product.

Recently there has been work done on the development of a steel carrying a higher percentage of silicon which has the effect of increasing both the ultimate strength and elastic limit without interfering with the ductility of the product.

# Part II

## General Mathematical Tables

Stresses:—Elementary Discussion

Properties of Sections

Moments of Inertia of Rectangles

Moments of Inertia of Four Angles

Areas of Rectangles

Weights of Rectangular Bars

Wire Gauges

Areas and Weights of Round and Square Bars

Beam Loading Formulae

Coopers E 10 Engine Loading

Deflection

Functions of Numbers .001 to 1000

Trigonometrical Formulae

Trigonometrical Tables

Lengths of Circular Arcs

# An Elementary Discussion of the Relation of External Loads and Internal Stresses

There is probably nothing so dangerous to safe construction as the blind use of empirical formulae. A formula is empirical so far as the user is concerned unless he understands it, and the fact that someone else may understand it does not change its empirical standing to the one who lacks the understanding.

Every engineer and architect now recognizes that an understanding of the relation of external loads to internal stresses in the materials which sustains the loads, is the basis of safety in the design of all structures. The necessity of such an understanding may be looked upon as almost an emergency with the present generation, due to the rapid transition from the "Iron Age" to the "Steel Age" which took place between 1885 and 1893 following the development of temperatures which enabled production of steel ingots from which all our steel products are manufactured. It has resulted in revolution of existing industrial conditions, and the evolution of new ones which mark a new era in human history. The industrial changes of the last forty or fifty years have been greater than those of all previous history. The development and distribution of technical information essential to such rapid progress has naturally been combined with much that seems mysterious and difficult for the uninitiated to understand.

It is the purpose of this discussion to place before the reader in elementary form and free from the difficult mathematical treatment it usually involves, one of the subjects on which much of our construction design depends.

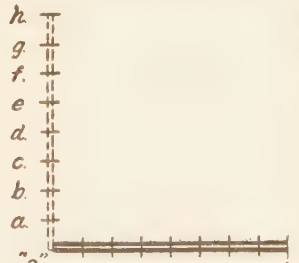


*Figure (1)*

Consider a steel bar eight feet long in a horizontal position shown in Figure 1, and assume that at each of the points, $a, b, c, d$, etc., there is one pound of material. If this bar is rotated to a vertical position as shown dotted, we know that work has been done. "*a*" has been lifted one foot and on it one foot pound of work was done. "*d*" has been lifted four feet and four foot pounds of work was done. "*h*" has been lifted eight feet and eight foot pounds of work was done. All of the work was done in the same time and we see at once, since the units each weighed a pound, there must have been a different force acting on each of them, and that this force must be proportional to the distance from the axis of rotation "O". That is, the force acting on "*a*" was one pound, on "*d*" four pounds, and on "*h*" eight pounds. In other words, the force representing the capacity of any body to resist being rotated about an axis is directly proportional to its distance from that axis. *Note clearly that this is not the moment of a force, but is the measure of the force itself.* The force acting on "*h*" is eight pounds, and since it is eight feet from the axis of rotation "O", the moment of the force will be $8\ \# \times 8' = 64'\ \#$. This establishes that the moment of resistance to rotation about the axis "O" is proportional to the square of the distance from the axis. An understanding of this will enable us to remove the mystery from the so called fourth dimension and make it rational.

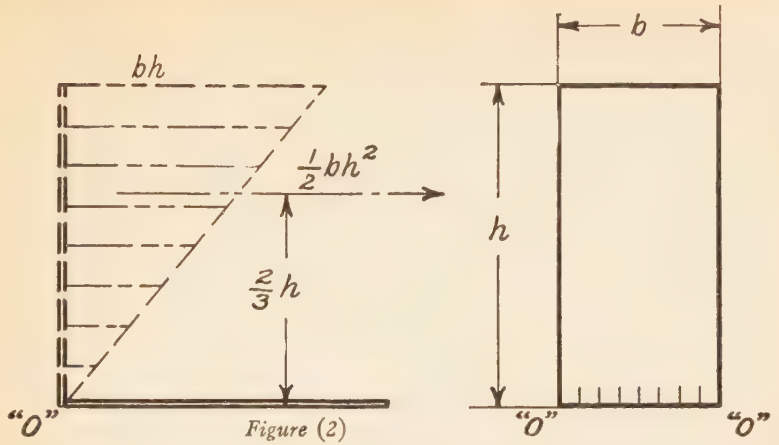



*Figure (2)*

If instead of a bar as in figure (1) we take several adjacent bars as shown in figure (2), we get a plate or rectangle whose height is $h$ and whose breadth is $b$, and we again consider rotation about the axis O – O.

For each unit of breadth the force at a distance $h$ from the axis will be $h$ pounds and for $b$ units of width the force is $b \times h$ pounds. This is represented graphically as $bh$ in the figure (2). Similarly, the various horizontal lines in the triangle represent forces proportional to their distance from O and the area of the triangle will be the total of all the forces. The area of the triangle is $\frac{1}{2}\ (bh \times h) = \frac{1}{2}\ bh^2$. This force $\frac{1}{2}\ bh^2$ is the inertia of the rectangle whose height is $h$ and breadth $b$ when it is resisting rotation about the axis O – O. The force $\frac{1}{2}\ bh^2$ may be properly considered as concentrated at its center of gravity which is also the center of gravity of the triangle, and is $\frac{2}{3}\ h$ from the axis O – O.

The moment about the axis O – O of the force $\frac{1}{2}\ bh^2$ is $\frac{1}{2}\ bh^2 \times \frac{2}{3}\ h$, or $\frac{1}{3}\ bh^3$, and is a fourth dimension quantity since it is $\frac{1}{3}$ the area of the rectangle $bh$ multiplied by the square of $h$ the height of the rectangle.

The quantity $\frac{1}{3}\ bh^3$ is the moment of inertia of the rectangle about the axis O – O which is its base.

It is, however, usual in the analysis of stress in material that the rotation of a given cross section takes place about the center of gravity of the cross section instead of about its base O above found. This condition is shown in figure (3) where the axis of rotation is X – X. In such a case we have the equivalent of two rectangles each rotating about their base, and in which $h$ of figure (2) becomes $h/2$. The moment of inertia in this case is therefore $2 \times \frac{1}{3}\ b\ (h/2)^3 = \frac{1}{12}\ bh^3$.

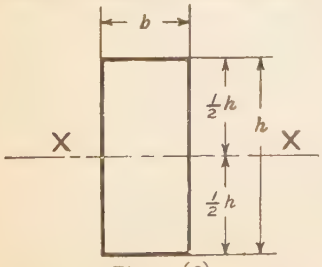



*Figure (3)*

The stresses which act in the materials of construction are classified as tension, compression or bearing, and shear. The action of pure tension is to elongate the material and reduce its area as it stretches. The action of compression is to shorten the specimen and

increase the area as it is compressed. The action of shear is to force the material on one side of a plane to slide along the material adjacent to it. One of the most familiar cases of shear is the punching of holes in a plate. Shear also exists in beams and girders, which also have tension and compression combined to form a couple to resist bending. It exists also in torsion where material is twisted as a shaft, and when a compression specimen is long enough shear acts along a plane at an angle to the axis of the specimen. Inasmuch as shear in the webs of beams and girders as well as in columns is combined with bearing or compression, the action is more properly described as one of crippling.

Consideration will now be given to the tension and compression stresses which form a couple to resist bending.

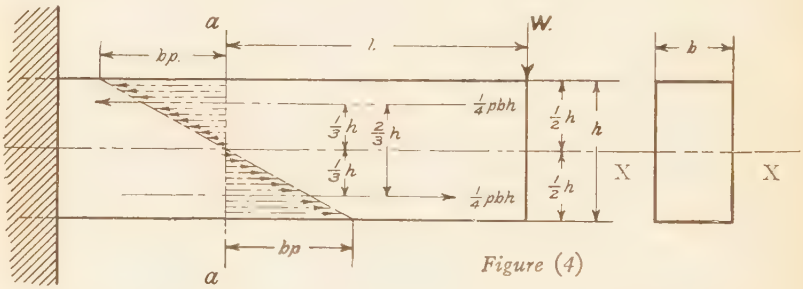



*Figure (4)*

Figure (4) represents a cantilever beam whose height is $h$ and breadth $b$, and with a load W at a distance $l$ from the cross section $a-a$. The maximum stress per square inch in tension or compression is $p$ pounds.

The effect of the load W is to cause the section $a-a$ to rotate in the direction of a clock about the axis X−X. The only thing to prevent $a-a$ from rotating is the tension and compression stresses in the material. Above the center of the beam the fibres are in tension, and below the center they are in compression. The condition is similar to figure (3) and the intensity of the stresses will be directly proportional to their distance from the center. The maximum allowable intensity is, however, fixed as $p$ pounds per square inch, and the total stress in the extreme fibre will be $b \times p$. The total stress for all fibres in tension or compression will be the area of the triangle, whose height is $h/2$ and whose breadth is $bp$.

This is $\frac{1}{2}\, bp \times h/2 = \frac{1}{4}\, bph$.

The effect of the tension and compression fibre stresses will be the same as if they were concentrated at the centers of gravity of the two triangles, and they will form a couple which balances the external bending moment. This balancing couple will therefore act opposite to the clock. The distance between the centers of gravity of the two triangles is $\frac{2}{3}\ h$ and the moment of the couple will be $\frac{1}{4}\, bph \times \frac{2}{3}h = \frac{1}{6}\, bph^2$ which is the moment of the internal stresses.

The moment of the external stresses M is $W \times l$.

From this we have the external moment $M = p \times \frac{1}{6}\, bh^2$.

In this we recognize the quantity $\frac{1}{6}\, bh^2$ as the section modulus of the rectangle $bh$, and the basic principle that the external moment M is equal to the stress per square inch in the extreme fibre multiplied by the section modulus (which is usually designated S.)

If we examine the value of the Section modulus we find that if it is multiplied by half the depth of the beam, or $h/2$ we get $\frac{1}{6}\,bh^2 \times h/2 = \frac{1}{12}\,bh^3$ which is the moment of inertia of the rectangle $bh$.

In other words, if we divide the moment of inertia by half the depth we get the section modulus, and the section modulus multiplied by the stress in the extreme fibre is the external moment.

In some text books half the depth $h/2$ is called $y$, and in others $c$, but as these are sometimes used in other connections in this discussion, $v$ will indicate $h/2$.

Starting from the equation $M = p \times \frac{1}{6}\,bh^2$ and multiplying both sides by the same quantity, or rather the left side by $v$, and the right by $h/2$ we get $M \times v = p \times \frac{1}{6}\,bh^2 \times h/2 = p \times \frac{1}{12}\,bh^3$ or $M\,v = pI$.

The fundamental principle involved in this elementrary discussion extends into almost every phase of construction, and a clear understanding of it will contribute much to the elimination of empirical solution, and to the establishing of rational analysis.

It has been the purpose in the foregoing discussion to present the subject in concrete practical form without complicating it with the development of general formulae. The rectangular cross-section has been used because it permits of the simplest mathematical analysis of a basic principle from which further development may proceed. While the design of structural steel seldom involves the use of a single rectangular cross section, it is usually possible to subdivide the section used into a number of rectangles or triangles, some of which will have to resist rotation about an axis which is neither at the base nor center of gravity of the rectangle. For this reason, it becomes necessary to have a formula for the moment of inertia of an area about an axis at a given distance from the center of gravity of the cross-section, and the development of this is given in connection with figure (5).

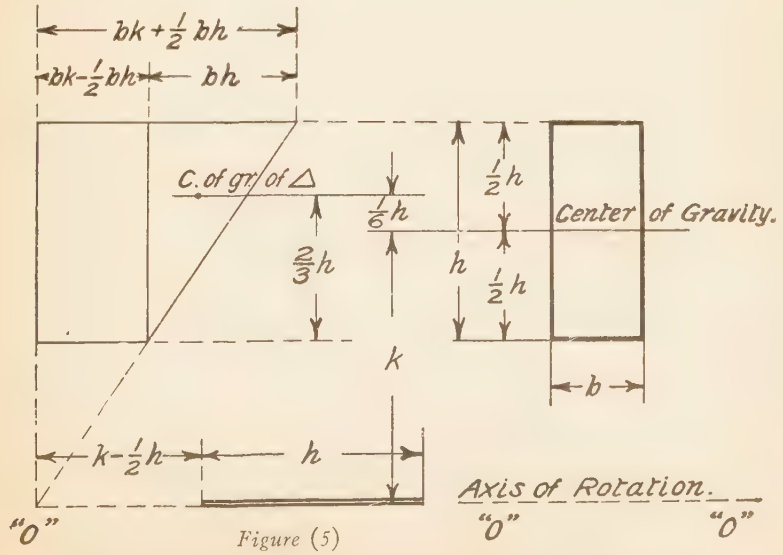



*Figure (5)*

This figure shows a rectangle with height $h$ and breadth $b$ rotating about an axis O – O which is a distance $k$ from the center of gravity of the rectangle.

The distance from the axis O – O to the top of the rectangle is $k + h/2$ and from previous developed data the force for each unit of breadth is proportional to this distance, and therefore $k + h/2$. For $b$ units of width, it will be $b$ times this or $b\ (k + h/2) = bk + bh/2$. This is shown graphically in the diagram. Similarly the force for $b$ units of width at the bottom of the rectangle or nearest the axis is $b\ k - bh/2$ which is also shown graphically. The total inertia or force resisting rotation about the axis O – O will be the area of the figure made up of the rectangle whose height is $h$, and breadth $bk - bh/2$ together with the triangle whose height is $h$ and breadth $b\ h$. The center of gravity of the rectangle is a distance $k$ from the axis, and that of the triangle a distance of $k + h/6$. The moment of inertia about the axis will be the areas of the rectangle and triangle multiplied by their respective distances. That is, the moment of inertia about axis O – O = area of rectangle $\times\ k +$ area of triangle $\times\ (k + h/6)$

$$= (b\ k - bh/2)\ h \times k + \tfrac{1}{2}\ b\ h^2\ (k + h/6)$$

$$= b\ h\ k^2 - bh^2k/2 + bh^2k/2 + \tfrac{1}{12}\ b\ h^3$$

$$= b\ h\ k^2 + \tfrac{1}{12}\ bh^3 = \text{Area} \times k^2 + \text{I}$$

Therefore, the moment of inertia of a rectangle about any axis is its moment of inertia about its center of gravity increased by the area of the rectangle multiplied by the square of the distance between the axis and the center of gravity.

In the analysis of the stresses in columns which fail by flexure the moment of inertia is used in a modified form which is called radius of gyration. The term "radius of gyration" is the distance from the axis of rotation at which, if the entire area were concentrated, it would have the same moment of inertia as the distributed area has. The formula for the moment of inertia of a rectangle about an axis through its center of gravity is

$$\text{I} = \tfrac{1}{12}\ bh^3 = bh \times \tfrac{1}{12}\ h^2$$

using A to equal the area $\text{A} = b\ h$ and substituting

$$\text{I} = \text{A} \times \tfrac{1}{12}\ h^2 = \text{A}\ h^2/12 = \text{A}\ (h/\sqrt{12})^2$$

In this equation $h/\sqrt{12}$ is the distance from the center of gravity that the entire area must be concentrated to give the same moment of inertia as the distributed area and $h/\sqrt{12}$ is called the radius of gyration which is designated $r$

Substituting $r$ for $h/\sqrt{12}$

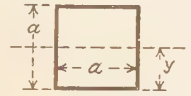
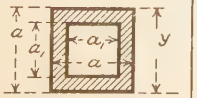
$\text{I} = \text{A}\ r^2$ or $r^2 = {}^{\text{I}}/_{\text{A}}$ and $r = \sqrt{{}^{\text{I}}/_{\text{A}}}$

# Nomenclature

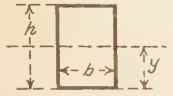
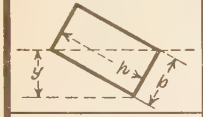
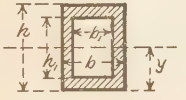
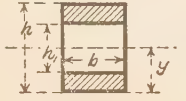
$I$ = Moment of Inertia
$S$ = Section Modulus
$r$ = Radius of Gyration
$h$ = height or depth
$b$ = breadth
$A$ = Area
X-X = Horizontal Axis
Y-Y = Vertical Axis
$x$ = distance along Horizontal Axis
$y$ = distance along Vertical Axis
$W$ = Total Load
$W, W_1$, etc. = Concentrated Loads
$R, R_1$, etc. = Reactions at the Supports
$M$ = Bending Moment
$M^1$ = Negative Bending Moment
$E$ = Modulus of Elasticity
$V$ = Vertical Shear
$D$ = Deflection

**Any deviation from the above nomenclature is clearly noted at place of exception.**

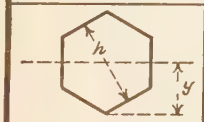
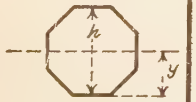
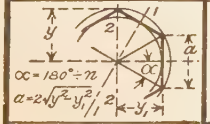
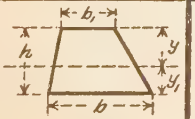
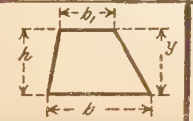
# PROPERTIES OF VARIOUS SECTIONS

| Section | Area of Section<br>$A$ | Distance from Axis to Extremities of Section<br>$y$ and $y_1$ | Moment of Inertia<br>$I$ | Section Modulus<br>$S = \frac{I}{y}$ | Radius of Gyration<br>$r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $a^2$ | $y = \frac{a}{2}$ | $\frac{a^4}{12}$ | $\frac{a^3}{6}$ | $\frac{a}{\sqrt{12}} = .289\,a$ |
| | $a^2$ | $y = a$ | $\frac{a^4}{3}$ | $\frac{a^3}{3}$ | $\frac{a}{\sqrt{3}} = .577\,a$ |
| | $a^2$ | $y = \frac{a}{\sqrt{2}} = .707\,a$ | $\frac{a^4}{12}$ | $\frac{a^3}{6\sqrt{2}} = .118\,a^3$ | $\frac{a}{\sqrt{12}} = .289\,a$ |
| | $a^2 - a_1^2$ | $y = \frac{a}{2}$ | $\frac{a^4 - a_1^4}{12}$ | $\frac{a^4 - a_1^4}{6\,a}$ | $\sqrt{\frac{a^2 + a_1^2}{12}}$ |
|  | $a^2 - a_1^2$ | $y = a$ | $\frac{a^4 - a_1^4}{3}$ | $\frac{a^4 - a_1^4}{3\,a}$ | $\sqrt{\frac{a^2 + a_1^2}{3}}$ |
| | $a^2 - a_1^2$ | $y = \frac{a}{\sqrt{2}} = .707\,a$ | $\frac{a^4 - a_1^4}{12}$ | $\frac{(a^4 - a_1^4)\sqrt{2}}{12\,a} = .118\,\frac{a^4 - a_1^4}{a}$ | $\sqrt{\frac{a^2 + a_1^2}{12}} = .289\sqrt{a^2 + a_1^2}$ |

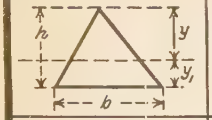
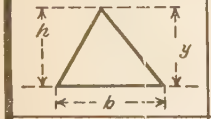
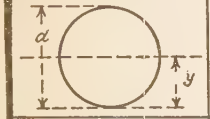
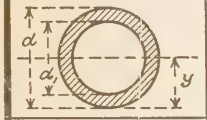
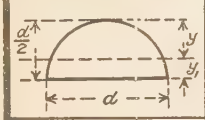
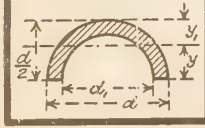
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section $A$ | Distance from Axis to Extremities of Section $y$ and $y_1$ | Moment of Inertia $I$ | Section Modulus $S = \frac{I}{y}$ | Radius of Gyration $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $bh$ | $y = \frac{h}{2}$ | $\frac{bh^3}{12}$ | $\frac{bh^2}{6}$ | $\frac{h}{\sqrt{12}} = .289\,h$ |
| | $bh$ | $y = h$ | $\frac{bh^3}{3}$ | $\frac{bh^2}{3}$ | $\frac{h}{\sqrt{3}} = .577\,h$ |
|  | $bh$ | $y = \frac{bh}{\sqrt{b^2 + h^2}}$ | $\frac{b^3h^3}{6\,(b^2 + h^2)}$ | $\frac{b^2h^2}{6\sqrt{b^2 + h^2}}$ | $\frac{bh}{\sqrt{6\,(b^2 + h^2)}}$ |
| | $bh$ | $y = \frac{h\cos\alpha + b\sin\alpha}{2}$ | $\frac{bh}{12}\left(h^2\cos^2\alpha + b^2\sin^2\alpha\right)$ | $\frac{bh}{6}\left(\frac{h^2\cos^2\alpha + b^2\sin^2\alpha}{h\cos\alpha + b\sin\alpha}\right)$ | $\sqrt{\frac{h^2\cos^2\alpha + b^2\sin^2\alpha}{12}}$ |
|  | $bh - b_1h_1$ | $y = \frac{h}{2}$ | $\frac{bh^3 - b_1h_1^3}{12}$ | $\frac{bh^3 - b_1h_1^3}{6h}$ | $\sqrt{\frac{bh^3 - b_1h_1^3}{12\,(bh - b_1h_1)}}$ |
|  | $b\,(h - h_1)$ | $y = \frac{h}{2}$ | $\frac{b\,(h^3 - h_1^3)}{12}$ | $\frac{b\,(h^3 - h_1^3)}{6h}$ | $\sqrt{\frac{h^3 - h_1^3}{12\,(h - h_1)}}$ |

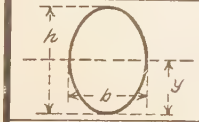
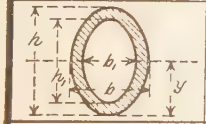
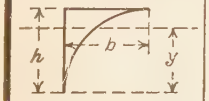
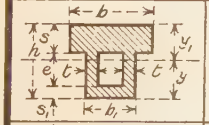
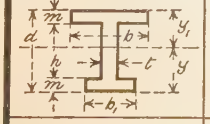
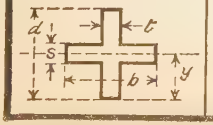
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section<br>$A$ | Distance from Axis to Extremities of Section<br>$y$ and $y_1$ | Moment of Inertia<br>$I$ | Section Modulus<br>$S = \frac{I}{y}$ | Radius of Gyration<br>$r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
| | $\frac{3}{2} h^2 \tan 30° = .866\, h^2$ | $y = \frac{h}{2}$ | $\frac{A}{12}\left[\frac{h^2 (1 + 2\cos^2 30°)}{4\cos^2 30°}\right] = .06\, h^4$ | $\frac{A}{6}\left[\frac{h (1 + 2\cos^2 30°)}{4\cos^2 30°}\right] = .12\, h^3$ | $\frac{h}{4\cos 30°}\sqrt{\frac{1 + 2\cos^2 30°}{3}} = .264\, h$ |
|  | $\frac{3}{2} h^2 \tan 30° = .866\, h^2$ | $y = \frac{h}{2\cos 30°} = .577\, h$ | $\frac{A}{12}\left[\frac{h^2 (1 + 2\cos^2 30°)}{4\cos^2 30°}\right] = .06\, h^4$ | $\frac{A}{6}\left[\frac{h (1 + 2\cos^2 30°)}{4\cos 30°}\right] = .104\, h^3$ | $\frac{h}{4\cos 30°}\sqrt{\frac{1 + 2\cos^2 30°}{3}} = .264\, h$ |
|  | $2 h^2 \tan 22\frac{1}{2}° = .828\, h^2$ | $y = \frac{h}{2}$ | $\frac{A}{12}\left[\frac{h^2 (1 + 2\cos^2 22\frac{1}{2}°)}{4\cos^2 22\frac{1}{2}°}\right] = .055\, h^4$ | $\frac{A}{6}\left[\frac{h (1 + 2\cos^2 22\frac{1}{2}°)}{4\cos 22\frac{1}{2}°}\right] = .109\, h^3$ | $\frac{h}{4\cos 22\frac{1}{2}°}\sqrt{\frac{1 + 2\cos^2 22\frac{1}{2}°}{3}} = .257\, h$ |
|  | $n$ = Number of Sides<br>$A = \frac{1}{4} na^2 \cot \alpha$<br>$= \frac{1}{2} ny^2 \sin 2\alpha$<br>$= ny_1^2 \tan \alpha$ | $y = \frac{a}{2 \sin \alpha}$<br>$y_1 = \frac{a}{2 \tan \alpha}$ | $I_{1-1} = \frac{A (6 y^2 - a^2)}{24}$<br>$I_{2-2} = \frac{A (12 y_1^2 + a^2)}{48}$ | $S_{1-1} = \frac{A (6 y^2 - a^2)}{24 y}$<br>$S_{2-2} = \frac{A (12 y_1^2 + a^2)}{48 y_1}$ | $r_{1-1} = \sqrt{\frac{6 y^2 - a^2}{24}}$<br>$r_{2-2} = \sqrt{\frac{12 y_1^2 + a^2}{48}}$ |
|  | $\frac{h (b + b_1)}{2}$ | $y = \frac{h (b_1 + 2b)}{3 (b_1 + b)}$<br>$y_1 = \frac{h (b + 2b_1)}{3 (b + b_1)}$ | $\frac{h^3 (b^2 + 4 bb_1 + b_1^2)}{36 (b + b_1)}$ | $\frac{h^2 (b^2 + 4 bb_1 + b_1^2)}{12 (b_1 + 2b)}$ | $\frac{h}{6 (b + b_1)}\sqrt{2 (b^2 + 4 bb_1 + b_1^2)}$ |
|  | $\frac{h (b + b_1)}{2}$ | $y = h$ | $\frac{h^3 (b + 3b_1)}{12}$ | $\frac{h^2 (b + 3b_1)}{12}$ | $\frac{h}{\sqrt{6}}\sqrt{\frac{b + 3 b_1}{b + b_1}}$ |

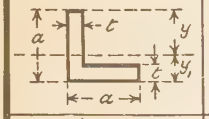
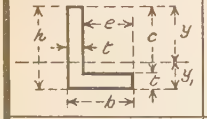
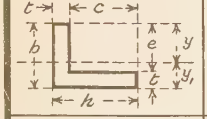
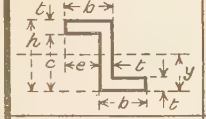
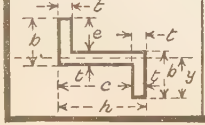
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section $A$ | Distance from Axis to Extremities of Section $y$ and $y_1$ | Moment of Inertia $I$ | Section Modulus $S = \frac{I}{y}$ | Radius of Gyration $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $\frac{bh}{2}$ | $y = \frac{2h}{3}$<br>$y_1 = \frac{h}{3}$ | $\frac{bh^3}{36}$ | $\frac{bh^2}{24}$ | $\frac{h}{\sqrt{18}} = .235702\,h$ |
|  | $\frac{bh}{2}$ | $y = h$ | $\frac{bh^3}{12}$ | $\frac{bh^2}{12}$ | $\frac{h}{\sqrt{6}} = .408248\,h$ |
|  | $\frac{\pi d^2}{4} = .785398\,d^2$ | $y = \frac{d}{2}$ | $\frac{\pi d^4}{64} = .049087\,d^4$ | $\frac{\pi d^3}{32} = .098175\,d^3$ | $\frac{d}{4}$ |
|  | $\frac{\pi (d^2 - d_1^2)}{4}$<br>$= .785398\,(d^2 - d_1^2)$ | $y = \frac{d}{2}$ | $\frac{\pi (d^4 - d_1^4)}{64} = .049087\,(d^4 - d_1^4)$ | $\frac{\pi (d^4 - d_1^4)}{32\,d}$<br>$= .098175\,\frac{d^4 - d_1^4}{d}$ | $\frac{\sqrt{d^2 + d_1^2}}{4}$ |
|  | $\frac{\pi d^2}{8} = .392699\,d^2$ | $y = \frac{d\,(3\pi - 4)}{6\pi} = .287793\,d$<br>$y_1 = \frac{2d}{3\pi} = .212207\,d$ | $\frac{d^4\,(9\pi^2 - 64)}{1152\,\pi} = .006860\,d^4$ | $\frac{d^3\,(9\pi^2 - 64)}{192\,(3\pi - 4)}$<br>$= .023836\,d^3$ | $\frac{d\sqrt{9\pi^2 - 64}}{12\,\pi}$<br>$= .132168\,d$ |
|  | $\frac{\pi (d^2 - d_1^2)}{8}$<br>$= .392699\,(d^2 - d_1^2)$ | $y = \frac{2\,(d^3 - d_1^3)}{3\,\pi\,(d^2 - d_1^2)}$<br>$y_1 = \frac{3\,\pi\,d\,(d^2 - d_1^2) - 4\,(d^3 - d_1^3)}{6\,\pi\,(d^2 - d_1^2)}$ | $\frac{9\pi^2\,(d^4 - d_1^4)\,(d^2 - d_1^2) - 64\,(d^3 - d_1^3)^2}{1152\,\pi\,(d^2 - d_1^2)}$ | $\frac{I}{y}$ if $y > y_1$<br>$\frac{I}{y_1}$ if $y_1 > y$ | $\sqrt{\frac{I}{A}}$ |

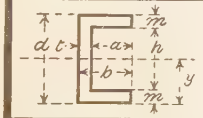
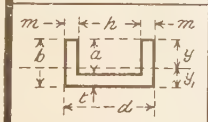
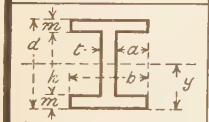
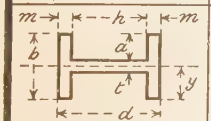
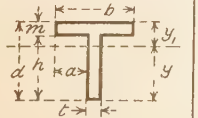
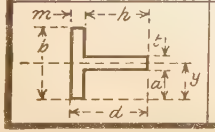
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section $A$ | Distance from Axis to Extremities of Section $y$ and $y_1$ | Moment of Inertia $I$ | Section Modulus $S = \frac{I}{y}$ | Radius of Gyration $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $\frac{\pi\, bh}{4} = .785\, bh$ | $\frac{h}{2}$ | $\frac{\pi\, bh^3}{64} = .049\, bh^3$ | $\frac{\pi\, bh^2}{32} = .098\, bh^2$ | $\frac{h}{4}$ |
|  | $\frac{\pi\,(bh - b_1h_1)}{4}$ $= .785\,(bh - b_1h_1)$ | $\frac{h}{2}$ | $\frac{\pi\,(bh^3 - b_1h_1^3)}{64}$ $= .049\,(bh^3 - b_1h_1^3)$ | $\frac{\pi\,(bh^3 - b_1h_1^3)}{32\,h}$ $= \frac{.098\,(bh^3 - b_1h_1^3)}{h}$ | $\frac{1}{4}\sqrt{\frac{bh^3 - b_1h_1^3}{bh - b_1h_1}}$ |
|  | $(b = h = r)$ $r^2 - \frac{\pi\, r^2}{4}$ $= .2146\, r^2$ | $\frac{r}{6\left(1 - \frac{\pi}{4}\right)}$ $= .7767\, r$ | $r^4\left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{36 - 9\,\pi}\right)$ $= .0075\, r^4$ | $\frac{I}{y}$ $= .00966\, r^3$ | $\sqrt{.03494\, r^2}$ $= .18693\, r$ |
|  | $bs + 2\,et + b_1s_1$ | $y = \frac{2th^2 + (b_1 - 2t)\,s_1^2 + (b - 2t)\,(2h - s)\,s}{2\,A}$ $y_1 = h - y$ | $\frac{b_1y^3 + by_1^3 - (b_1 - 2t)\,(y - s_1)^3}{3}$ $- \frac{(b - 2t)\,(y_1 - s)^3}{3}$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $bm + ht + b_1m$ | $y = d - y_1$ $y_1 = \frac{td^2 + m^2\,(b - t) + m\,(b_1 - t)\,(2d - m)}{2\,A}$ | $\frac{by_1^3 + b_1y^3 - (b - t)\,(y_1 - m)^3}{3}$ $- \frac{(b_1 - t)\,(y - m)^3}{3}$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $td + s\,(b - t)$ | $\frac{d}{2}$ | $\frac{td^3 + s^3\,(b - t)}{12}$ | $\frac{td^3 + s^3\,(b - t)}{6\,d}$ | $\sqrt{\frac{td^3 + s^3\,(b - t)}{12\,[td + s\,(b - t)]}}$ |

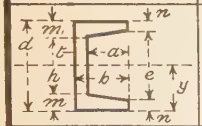
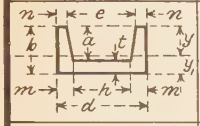
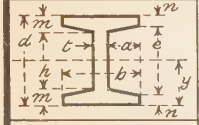
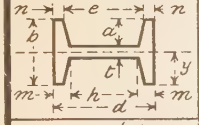
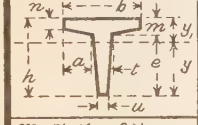
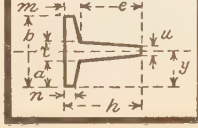
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section $A$ | Distance from Axis to Extremities of Section $y$ and $y_1$ | Moment of Inertia $I$ | Section Modulus $S = \frac{I}{y}$ | Radius of Gyration $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $t\,(2a - t)$ | $y = a - \frac{a^2 + at - t^2}{2\,(2a - t)}$<br>$y_1 = \frac{a^2 + at - t^2}{2\,(2a - t)}$ | $\frac{1}{3}\left[ty^3 + a\,(a-y)^3 - (a-t)\,(a-y-t)^3\right]$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
| | $t\,(2a - t)$ | $y = \frac{a^2 + at - t^2}{2\,(2a - t)\cos 45°}$<br>$y_1 = \sin 45°\,(a + t) - y$<br>$= .70711\,(a + t) - y$ | When $x = a^2 + at - t^2 \div 2\,(2a - t)$<br>$\frac{1}{3}\left[2x^4 - 2\,(x - t)^4 + t\left[a - \left(2x - \frac{t}{2}\right)\right]^3\right]$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $t\,(b + h - t)$ | $y = h - \frac{t\,(b + 2c) + c^2}{2\,(b + c)}$<br>$y_1 = \frac{t\,(b + 2c) + c^2}{2\,(b + c)}$ | $\frac{1}{3}\left[t\,(h - y_1)^3 + by_1^3 - e\,(y_1 - t)^3\right]$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $t\,(b + h - t)$ | $y = h - \frac{t\,(h + 2e) + e^2}{2\,(h + e)}$<br>$y_1 = \frac{t\,(h + 2e) + e^2}{2\,(h + e)}$ | $\frac{1}{3}\left[t\,(b - y_1)^3 + hy_1^3 - c\,(y_1 - t)^3\right]$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $t\,(h + 2e)$ | $y = \frac{h}{2}$ | $\frac{1}{12}\left[bh^3 - e\,(h - 2t)^3\right]$ | $\frac{bh^3 - e\,(h - 2t)^3}{6h}$ | $\sqrt{\frac{bh^3 - e\,(h - 2t)^3}{12\,t\,(h + 2e)}}$ |
|  | $t\,(h + 2e)$ | $y = \frac{2b - t}{2}$ | $\frac{1}{12}\left[h\,(b + e)^3 - 2\,e^3c - 6\,eb^2c\right]$ | $\frac{h\,(b + e)^3 - 2e^3c - 6\,eb^2c}{6\,(2b - t)}$ | $\sqrt{\frac{h\,(b + e)^3 - 2\,e^3c - 6\,eb^2c}{6\,(2b - t)}}$ |

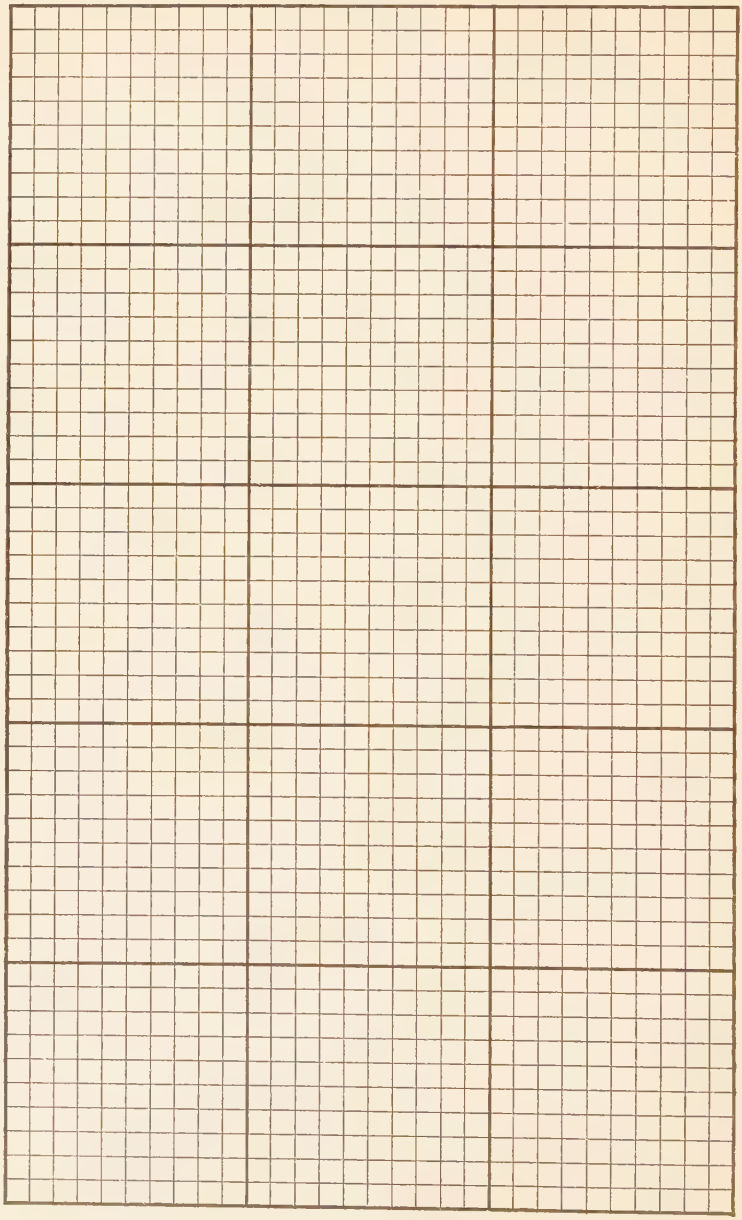
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section $A$ | Distance from Axis to Extremities of Section $y$ and $y_1$ | Moment of Inertia $I$ | Section Modulus $S = \frac{I}{y}$ | Radius of Gyration $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $bd - ah$ | $y = \frac{d}{2}$ | $\frac{1}{12}(bd^3 - ah^3)$ | $\frac{bd^3 - ah^3}{6d}$ | $\sqrt{\frac{bd^3 - ah^3}{12(bd - ah)}}$ |
|  | $bd - ah$ | $y = b - y_1$<br>$y_1 = \frac{2b^2m + ht^2}{2A}$ | $\frac{1}{3}(2mb^3 + ht^3) - Ay_1^2$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $bd - 2ah$ | $y = \frac{d}{2}$ | $\frac{1}{12}(bd^3 - 2ah^3)$ | $\frac{bd^3 - 2ah^3}{6d}$ | $\sqrt{\frac{I}{A}}$ |
|  | $bd - 2ah$ | $y = \frac{b}{2}$ | $\frac{1}{12}(2mb^3 + ht^3)$ | $\frac{2mb^3 + ht^3}{6b}$ | $\sqrt{\frac{I}{A}}$ |
|  | $bm + ht$ | $y = d - y_1$<br>$y_1 = \frac{d^2t + m^2(b - t)}{2A}$ | $\frac{1}{3}\left(ty^3 + by_1^3 - 2a(y_1 - m)^3\right)$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $bm + ht$ | $y = \frac{b}{2}$ | $\frac{1}{12}(mb^3 + ht^3)$ | $\frac{mb^3 + ht^3}{6b}$ | $\sqrt{\frac{I}{A}}$ |

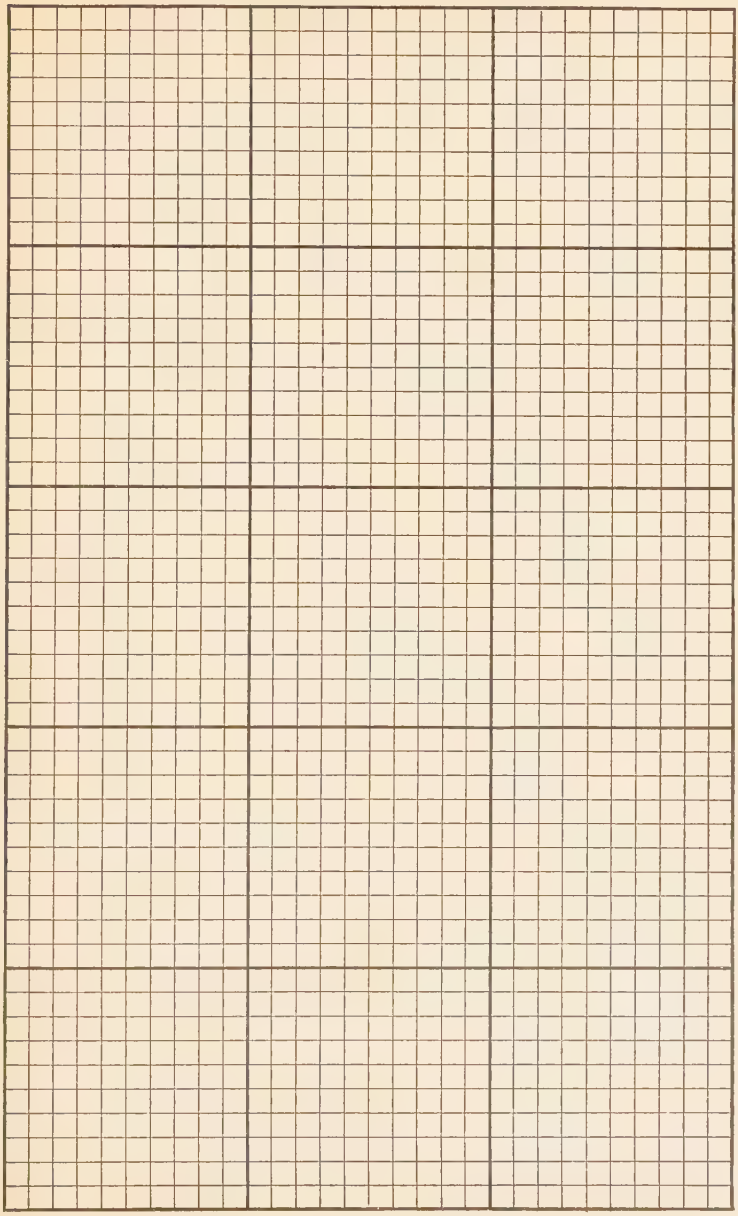
# PROPERTIES OF VARIOUS SECTIONS

| Sections | Area of Section $A$ | Distance from Axis to Extremities of Section $y$ and $y_1$ | Moment of Inertia $I$ | Section Modulus $S = \frac{I}{y}$ | Radius of Gyration $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|---|---|---|
|  | $td + a(m + n)$ | $y = \frac{d}{2}$ | $\frac{1}{12}\left[ bd^3 - \frac{a}{8(m-n)}(e^4 - h^4) \right]$ | $\frac{2I}{d}$ | $\sqrt{\frac{I}{A}}$ |
|  | $td + a(m + n)$ | $y = b - y_1$<br>$y_1 = \frac{b^2 n + \frac{et^2}{2} + \frac{a(m-n)}{3}\left(b + 2t\right)}{A}$ | $\frac{1}{3}\left[ 2nb^3 + ht^3 + \frac{m-n}{2a}(b^4 - t^4) \right] - Ay_1^2$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $td + 2a(m + n)$ | $y = \frac{d}{2}$ | $\frac{1}{12}\left[ bd^3 - \frac{a}{4(m-n)}(e^4 - h^4) \right]$ | $\frac{2I}{d}$ | $\sqrt{\frac{I}{A}}$ |
|  | $td + 2a(m + n)$ | $y = \frac{b}{2}$ | $\frac{1}{12}\left[ 2nb^3 + ht^3 + \frac{m-n}{4a}(b^4 - t^4) \right]$ | $\frac{2I}{b}$ | $\sqrt{\frac{I}{A}}$ |
|  | $\frac{e(t+u)}{2} + tm + a(m + n)$ | $y = h - y_1$<br>$y_1 = [6an^2 + 2a(m-n)(m+2n) + 3td^2 - e(t-u)(3d-e)] \div 6A$ | $\frac{1}{12}\left[ e^3(3u+t) + 4bm^3 - 2a(m-n)^3 \right] - A(y_1 - m)^2$ | $\frac{I}{y}$ | $\sqrt{\frac{I}{A}}$ |
|  | $\frac{e(t+u)}{2} + tm + a(m + n)$ | $y = \frac{b}{2}$ | $\frac{nb^3 + (m-n)t^3 + eu^3}{12} + \frac{a(m-n)[2a^2 + (2a+3t)^2]}{36} + \frac{e(t-u)[(t-u)^2 + 2(t+2u)]}{144}$ | $\frac{2I}{b}$ | $\sqrt{\frac{I}{A}}$ |

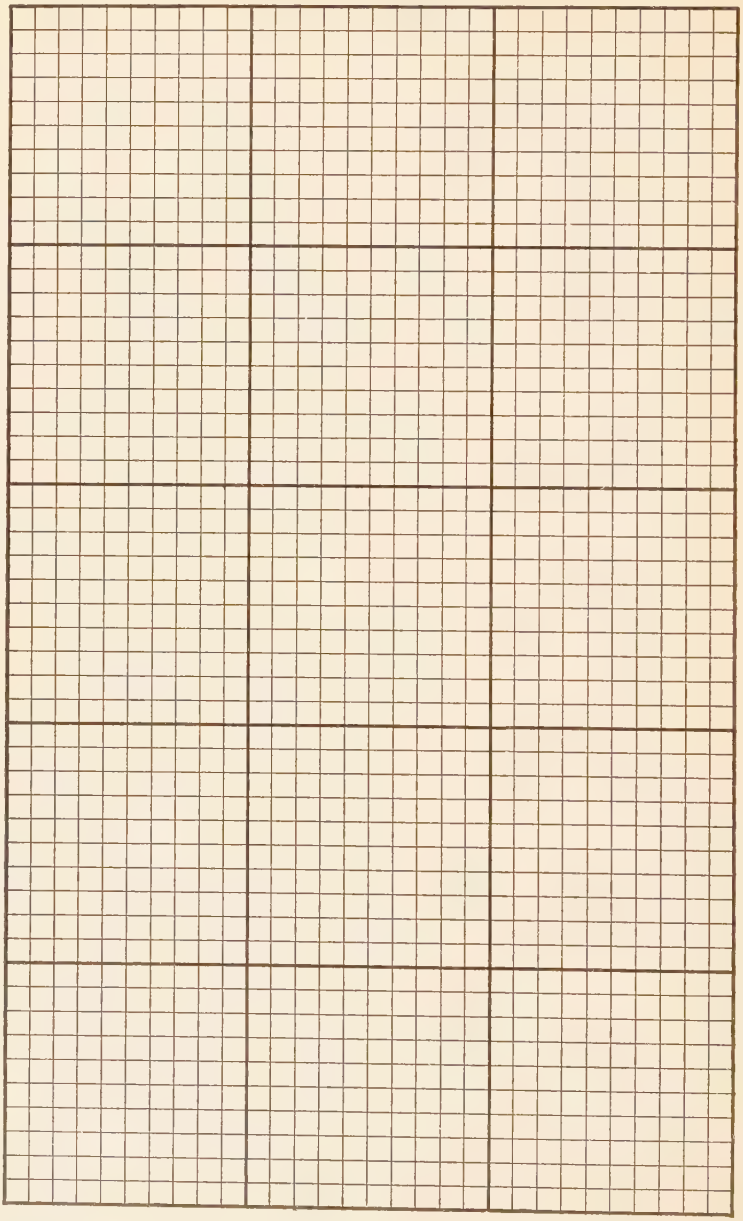
## NOTES and DIAGRAMS



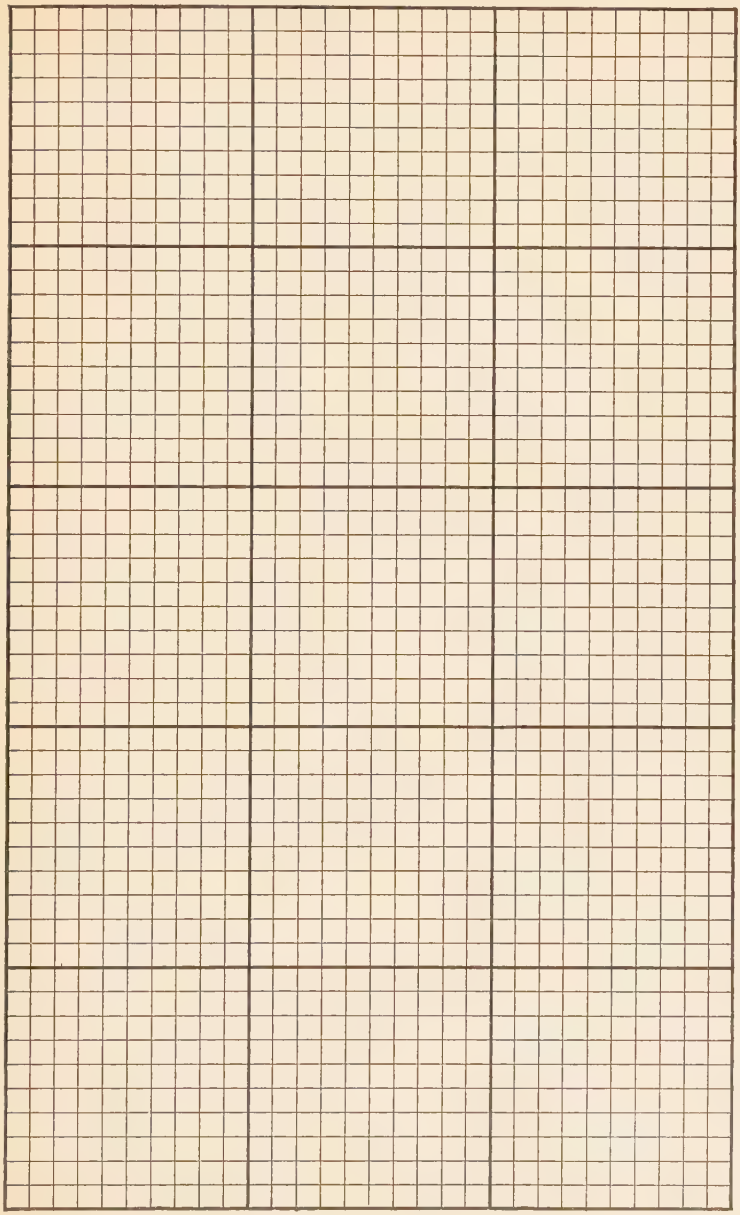
## NOTES and DIAGRAMS



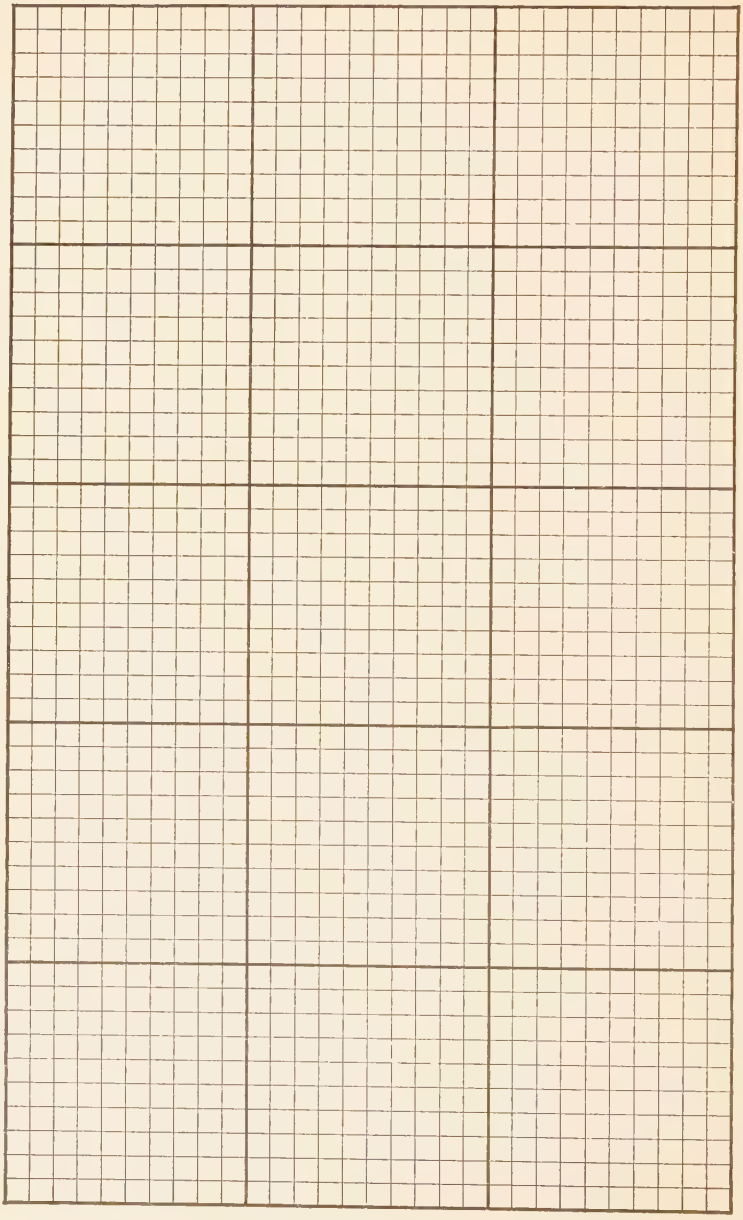
## NOTES and DIAGRAMS



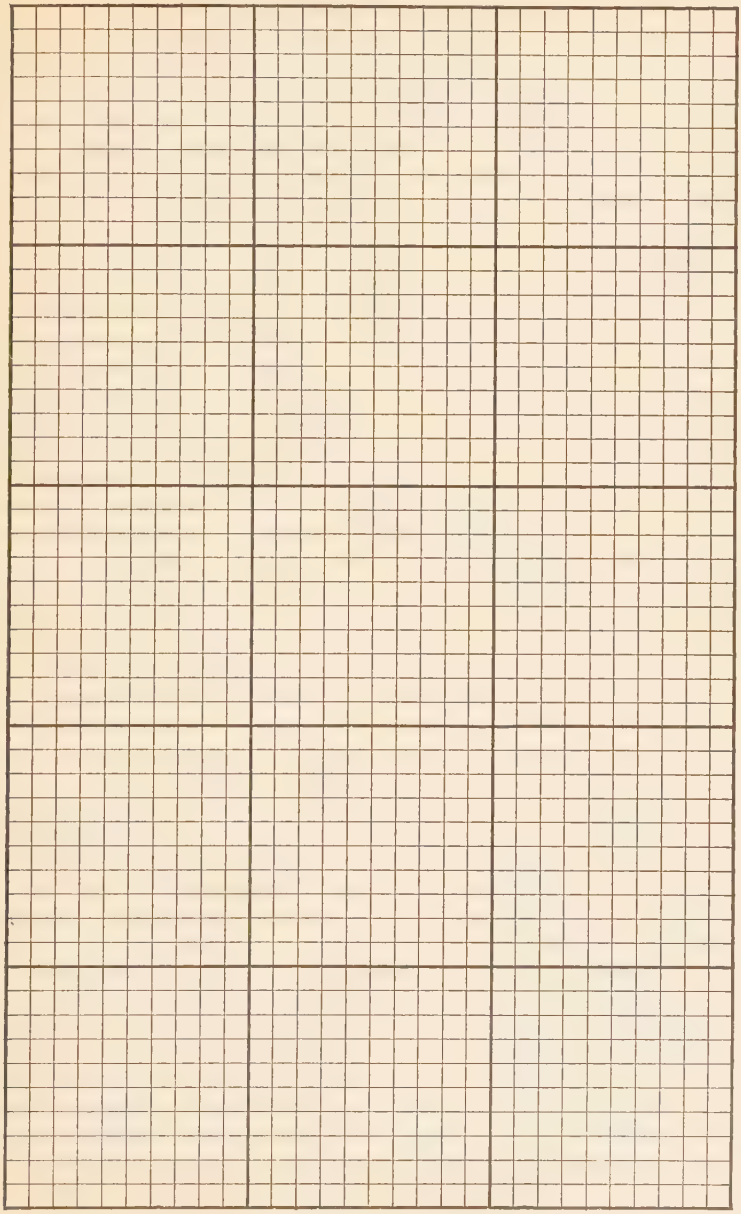
## NOTES and DIAGRAMS

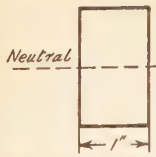


## NOTES and DIAGRAMS



## NOTES and DIAGRAMS






# MOMENTS OF INERTIA OF RECTANGLES
## ABOUT THE NEUTRAL AXIS

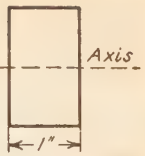
Values given are the Moments of Inertia for Rectangles
ONE INCH WIDE

The value for any width rectangle may be obtained from value given by direct multiplication

| *h* in Inches | Additional Height *h*. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 1/16 .0625 | 1/8 .125 | 3/16 .1875 | 1/4 .250 | 5/16 .3125 | 3/8 .375 | 7/16 .4375 |
| 0 | ..... | .00002 | .00016 | .00055 | 00130 | .00254 | 00439 | .00698 |
| 1 | 08333 | .09995 | .11865 | 13955 | 16276 | 18842 | .21663 | .24754 |
| 2 | .66667 | .73114 | .79964 | .87229 | .94922 | 1.0305 | 1.1164 | 1.2068 |
| 3 | 2.2500 | 2.3936 | 2.5431 | 2.6988 | 2.8607 | 3 0289 | 3.2036 | 3.3849 |
| 4 | 5.3333 | 5.5873 | 5.8491 | 6.1190 | 6.3971 | 6.6002 | 6.9783 | 7.2817 |
| 5 | 10.417 | 10.812 | 11.218 | 11 633 | 12 059 | 12.494 | 12.941 | 13.397 |
| 6 | 18.000 | 18.568 | 19.149 | 19 741 | 20.345 | 20.961 | 21.590 | 22.232 |
| 7 | 28.583 | 29.356 | 30.142 | 30 942 | 31.757 | 32 585 | 33 428 | 34.285 |
| 8 | 42.667 | 43 674 | 44.698 | 45.737 | 46.793 | 47.864 | 48 952 | 50.056 |
| 9 | 60.750 | 62.024 | 63.317 | 64.626 | 65.954 | 67.300 | 68 665 | 70.047 |
| 10 | 83.333 | 84.906 | 86.498 | 88.109 | 89.741 | 91.392 | 93.064 | 94.756 |
| 11 | 110.92 | 112.82 | 114.74 | 116 69 | 118 65 | 120.64 | 122.65 | 124.68 |
| 12 | 144.00 | 146.26 | 148.55 | 150.86 | 153.19 | 155.55 | 157.93 | 160.33 |
| 13 | 183.08 | 185 74 | 188.42 | 191.12 | 193 85 | 196.61 | 199.39 | 202 20 |
| 14 | 228.67 | 231.74 | 234.85 | 237 98 | 241.14 | 244.32 | 247.54 | 250.78 |
| 15 | 281.25 | 284.78 | 288.34 | 291.93 | 295.55 | 299.20 | 302 87 | 306.58 |
| 16 | 341.33 | 345.35 | 349.40 | 353.47 | 357.58 | 361.73 | 365.90 | 370.11 |
| 17 | 409.42 | 413 95 | 418.52 | 423.11 | 427.75 | 432 41 | 437.11 | 441.85 |
| 18 | 486.00 | 491.41 | 496.20 | 501.35 | 506.53 | 511 75 | 517 01 | 522.31 |
| 19 | 571.58 | 577.24 | 582.94 | 588.67 | 594.44 | 600.25 | 606.10 | 611.98 |
| 20 | 666.67 | 672.94 | 679.24 | 685.59 | 691.84 | 698.41 | 704 87 | 711.38 |
| 21 | 771.75 | 778.66 | 785.61 | 792 61 | 799.65 | 806 72 | 813 84 | 821.00 |
| 22 | 887.33 | 894 92 | 902.54 | 910.21 | 917.93 | 925 68 | 933 49 | 941.33 |
| 23 | 1013.9 | 1022 2 | 1030.5 | 1038.9 | 1047.3 | 1055 8 | 1064 3 | 1072.9 |
| 24 | 1152.0 | 1161.0 | 1170.1 | 1178.4 | 1188.4 | 1197.6 | 1206.8 | 1216.2 |
| 25 | 1302.1 | 1311.9 | 1321.7 | 1331 6 | 1341.5 | 1351 5 | 1361.6 | 1371.6 |
| 26 | 1464.7 | 1475 3 | 1485.9 | 1496.6 | 1507.3 | 1518 1 | 1529.0 | 1539.9 |
| 27 | 1640.2 | 1651 7 | 1663.1 | 1674.7 | 1686.2 | 1697 9 | 1709.5 | 1721.3 |
| 28 | 1829.3 | 1841.6 | 1853.9 | 1866.3 | 1878.8 | 1891 3 | 1903.8 | 1916.4 |
| 29 | 2032.4 | 2045 6 | 2058.8 | 2072.1 | 2085.4 | 2098.8 | 2112 3 | 2125.8 |
| 30 | 2250.0 | 2264.1 | 2278.2 | 2292.4 | 2306.7 | 2321.0 | 2335.4 | 2349.9 |
| 31 | 2482.6 | 2497 6 | 2512.7 | 2527.9 | 2543 1 | 2558 4 | 2573.8 | 2589.2 |
| 32 | 2730.7 | 2746 7 | 2762.8 | 2778.9 | 2795.2 | 2811.4 | 2827.8 | 2844.2 |
| 33 | 2994.7 | 3011 8 | 3028.9 | 3046.1 | 3063.3 | 3080.4 | 3098.0 | 3115.4 |
| 34 | 3275.3 | 3293.4 | 3311.6 | 3329.8 | 3348.1 | 3366 5 | 3384.9 | 3403.4 |
| 35 | 3572.9 | 3592 0 | 3611.3 | 3630 6 | 3650.0 | 3669 5 | 3689.0 | 3708 6 |
| 36 | 3888.0 | 3908 3 | 3928.6 | 3949.1 | 3969.6 | 3990 1 | 4010.8 | 4031.5 |
| 37 | 4221.1 | 4242 5 | 4264.0 | 4285.6 | 4307.3 | 4328 9 | 4350.7 | 4372 6 |
| 38 | 4572 7 | 4595 3 | 4617.9 | 4640.7 | 4663.5 | 4686 4 | 4719.4 | 4732.4 |
| 39 | 4943.3 | 4967 0 | 4990.9 | 5014.9 | 5038.9 | 5063.0 | 5087.2 | 5111.5 |
| 40 | 5333.3 | 5358 4 | 5383.5 | 5408.7 | 5433.9 | 5459.3 | 5484.7 | 5510.2 |
| 41 | 5743 4 | 5769 7 | 5796.1 | 5822 6 | 5849.1 | 5875 7 | 5902.5 | 5929.2 |
| 42 | 6174.0 | 6201 6 | 6229.3 | 6257.1 | 6284.9 | 6312.8 | 6340.9 | 6368.9 |
| 43 | 6625.6 | 6654 5 | 6683.5 | 6703.5 | 6741.8 | 6771.1 | 6800.4 | 6829.9 |
| 44 | 7098.7 | 7129 0 | 7159.3 | 7189.0 | 7220.3 | 7251.0 | 7281 7 | 7312.5 |
| 45 | 7593.8 | 7625 4 | 7657.2 | 7689.1 | 7721.0 | 7753.0 | 7785 2 | 7817.4 |
| 46 | 8111.3 | 8144.7 | 8177.6 | 8210.9 | 8444.3 | 8277.8 | 8311.3 | 8345.0 |
| 47 | 8651.9 | 8686 5 | 8721.1 | 8755.9 | 8790.7 | 8825.6 | 8860.7 | 8895.8 |
| 48 | 9216.0 | 9252 0 | 9288.2 | 9324.4 | 9360.7 | 9397.2 | 9433 7 | 9470.3 |
| 49 | 9804.1 | 9841.6 | 9879.3 | 9833 7 | 9954.9 | 9992 9 | 10031 | 10071 |
| 50 | 10417 | 10456 | 10495 | 10534 | 10574 | 10613 | 10653 | 10692 |
| 51 | 11054 | 11095 | 11136 | 11177 | 11218 | 11259 | 11300 | 11341 |
| 52 | 11717 | 11760 | 11802 | 11845 | 11887 | 11930 | 11973 | 12016 |
| 53 | 12406 | 12450 | 12494 | 12539 | 12583 | 12627 | 12672 | 12716 |
| 54 | 13122 | 13168 | 13213 | 13259 | 13305 | 13351 | 13397 | 13444 |
| 55 | 13865 | 13912 | 13959 | 14007 | 14055 | 14102 | 14150 | 14198 |
| 56 | 14635 | 14684 | 14733 | 14782 | 14832 | 14881 | 14931 | 14980 |
| 57 | 15433 | 15484 | 15535 | 15586 | 15637 | 15688 | 15739 | 15791 |
| 58 | 16259 | 16312 | 16365 | 16418 | 16470 | 16524 | 16577 | 16630 |
| 59 | 17115 | 17169 | 17224 | 17279 | 17333 | 17388 | 17443 | 17498 |

# MOMENTS OF INERTIA OF RECTANGLES

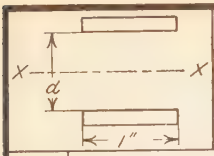
## ABOUT THE NEUTRAL AXIS




Values given are the Moments of Inertia for Rectangles ONE INCH WIDE

The value for any width rectangle may be obtained from value given by direct multiplication

| *h* | Additional Height *h*. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| in | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 |
| Inches | .500 | .5625 | .625 | .6875 | .750 | .8125 | .875 | .9375 |
| 0 | .01041 | .01483 | .02034 | .02708 | .03516 | .04469 | .05583 | .06866 |
| 1 | .28125 | .31789 | .35758 | .40045 | .44661 | .49620 | .54932 | .60610 |
| 2 | 1.3021 | 1.4022 | 1.5073 | 1.6176 | 1.7331 | 1.8539 | 1.9803 | 2.1123 |
| 3 | 3.5729 | 3.7678 | 3.9696 | 4.1784 | 4.3945 | 4.6179 | 4.8488 | 5.0872 |
| 4 | 7.5937 | 7.9146 | 8.2443 | 8.5831 | 8.9310 | 9.2882 | 9.6548 | 10.031 |
| 5 | 13.865 | 14.343 | 14.832 | 15.331 | 15.843 | 16.365 | 16.898 | 17.443 |
| 6 | 22.885 | 23.552 | 24.231 | 24.924 | 25.629 | 26.347 | 27.079 | 27.825 |
| 7 | 35.156 | 36.043 | 36.944 | 37.859 | 38.790 | 39.736 | 40.698 | 41.674 |
| 8 | 51.177 | 52.314 | 53.468 | 54.639 | 55.827 | 57.032 | 58.254 | 59.493 |
| 9 | 71.448 | 72.867 | 74.305 | 75.762 | 77.238 | 78.733 | 80.247 | 81.780 |
| 10 | 96.469 | 98.202 | 99.955 | 101.73 | 103.52 | 105.34 | 107.18 | 109.04 |
| 11 | 126.74 | 128.82 | 130.92 | 133.04 | 135.19 | 137.35 | 139.55 | 141.76 |
| 12 | 162.76 | 165.21 | 167.69 | 170.19 | 172.72 | 175 28 | 177.85 | 180.46 |
| 13 | 205.03 | 207.89 | 210.78 | 213.69 | 216.63 | 219.60 | 222.60 | 225.62 |
| 14 | 254.05 | 257.35 | 260.68 | 264.04 | 267.42 | 270.83 | 274.28 | 277.75 |
| 15 | 310.32 | 314.09 | 317.89 | 321.72 | 325.58 | 329.47 | 333.40 | 337.35 |
| 16 | 374.34 | 378.61 | 382.92 | 387.25 | 391.62 | 396.02 | 400.45 | 404.92 |
| 17 | 446.61 | 451.42 | 456.25 | 461.12 | 466.03 | 470.97 | 475.94 | 480.95 |
| 18 | 527.63 | 533.00 | 538.40 | 543.84 | 549.32 | 554.83 | 560.38 | 565.96 |
| 19 | 617.91 | 623.87 | 629.87 | 635.90 | 641.98 | 648 09 | 654.24 | 660.44 |
| 20 | 717.93 | 724.51 | 731.14 | 737.81 | 744.51 | 751.26 | 758.05 | 764.88 |
| 21 | 828.20 | 835.44 | 842.73 | 850.05 | 857.43 | 864.84 | 872.29 | 879.79 |
| 22 | 949.22 | 957.15 | 965.13 | 973.15 | 981.21 | 989.32 | 997.47 | 1005.7 |
| 23 | 1081.5 | 1090.1 | 1098.8 | 1107.6 | 1116.4 | 1225.2 | 1134.1 | 1143.0 |
| 24 | 1225.5 | 1234.9 | 1244.4 | 1253.9 | 1263.4 | 1273.0 | 1282.6 | 1292.3 |
| 25 | 1381.8 | 1392.0 | 1402.2 | 1412.5 | 1422.8 | 1433.2 | 1443.6 | 1454.1 |
| 26 | 1550.8 | 1561.8 | 1572.8 | 1584.0 | 1595.1 | 1606.3 | 1617.6 | 1628.9 |
| 27 | 1733.1 | 1744.9 | 1756.8 | 1768.8 | 1780.8 | 1792.8 | 1804.9 | 1817.1 |
| 28 | 1929.1 | 1941.8 | 1954.6 | 1967.4 | 1980.3 | 1993.2 | 2006.2 | 2019.3 |
| 29 | 2139.4 | 2153.0 | 2166.7 | 2180.4 | 2194.2 | 2208.1 | 2222.0 | 2236.0 |
| 30 | 2364.4 | 2378.9 | 2393.6 | 2408.3 | 2423.0 | 2437.8 | 2452.7 | 2467.6 |
| 31 | 2604.7 | 2620.2 | 2635.8 | 2651.4 | 2667.2 | 2682.9 | 2698.8 | 2714.7 |
| 32 | 2860.7 | 2877.2 | 2893.8 | 2910.5 | 2927.2 | 2944.0 | 2960.8 | 2977.8 |
| 33 | 3132.9 | 3150.5 | 3168.1 | 3185.8 | 3203.6 | 3221.4 | 3239.3 | 3257.3 |
| 34 | 3422.0 | 3440.6 | 3459.3 | 3478.1 | 3496.9 | 3515.8 | 3534.8 | 3553.8 |
| 35 | 3728.2 | 3748.0 | 3767.8 | 3787.6 | 3807.6 | 3827.6 | 3847.6 | 3867.8 |
| 36 | 4052.3 | 4073.1 | 4094.0 | 4115.0 | 4136.1 | 4157.2 | 4178.4 | 4199.7 |
| 37 | 4394.5 | 4416.5 | 4438.6 | 4460 8 | 4483.0 | 4505 3 | 4527.7 | 4550.1 |
| 38 | 4755.5 | 4778.7 | 4802.0 | 4825 4 | 4848.8 | 4872.3 | 4895.9 | 4919.5 |
| 39 | 5135.8 | 5160.2 | 5184.7 | 5209.3 | 5239.6 | 5285.3 | 5283.5 | 5308.4 |
| 40 | 5535.8 | 5561.5 | 5587.3 | 5613 1 | 5639.0 | 5665.0 | 5691.0 | 5717.2 |
| 41 | 5956.1 | 5983.1 | 6010.1 | 6037.0 | 6064.4 | 6091.7 | 6119.0 | 6146.5 |
| 42 | 6397.1 | 6425.4 | 6453.7 | 6482.2 | 6510.7 | 6539.3 | 6568.0 | 6596.7 |
| 43 | 6867.7 | 6889.0 | 6918.7 | 6948 5 | 6978.3 | 7008.3 | 7038.3 | 7068.5 |
| 44 | 7343.4 | 7374.4 | 7405.5 | 7436.6 | 7467.9 | 7499.2 | 7530.6 | 7562.1 |
| 45 | 7849.7 | 7882.1 | 7914.6 | 7947.1 | 7979.8 | 8012.5 | 8045.4 | 8078.3 |
| 46 | 8378.7 | 8412.5 | 8466.5 | 8480.5 | 8514.6 | 8548.8 | 8583.1 | 8617.4 |
| 47 | 8931.0 | 8966.3 | 9001.7 | 9037.2 | 9072.7 | 9108.4 | 9144.2 | 9180.0 |
| 48 | 9507.0 | 9544.1 | 9580.7 | 9617 7 | 9654.8 | 9692.0 | 9729.2 | 9766.6 |
| 49 | 10107 | 10146 | 10184 | 10223 | 10261 | 10300 | 10339 | 10378 |
| 50 | 10732 | 10772 | 10812 | 10852 | 10892 | 10933 | 10973 | 11014 |
| 51 | 11383 | 11424 | 11466 | 11507 | 11549 | 11591 | 11633 | 11675 |
| 52 | 12059 | 12102 | 12145 | 12188 | 12232 | 12275 | 12319 | 12363 |
| 53 | 12761 | 12806 | 12851 | 12896 | 12941 | 12986 | 13031 | 13076 |
| 54 | 13490 | 13536 | 13583 | 13630 | 13676 | 13723 | 13770 | 13817 |
| 55 | 14246 | 14294 | 14343 | 14391 | 14440 | 14488 | 14537 | 14586 |
| 56 | 15030 | 15080 | 15130 | 15180 | 15231 | 15281 | 15331 | 15382 |
| 57 | 15842 | 15894 | 15946 | 15998 | 16050 | 16102 | 16154 | 16207 |
| 58 | 16683 | 16737 | 16791 | 16844 | 16898 | 16952 | 17006 | 17061 |
| 59 | 17554 | 17609 | 17665 | 17720 | 17776 | 17832 | 17888 | 17944 |



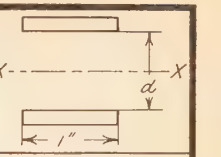

# MOMENTS OF INERTIA OF TWO PLATES

Moments of Inertia of Two Plates ONE INCH WIDE About Axis X—X.
Depths measured between Plates.

To obtain the Moment of Inertia of two plates of any desired width multiply the Tabular Value given for the correct thickness and depth between plates by the net width.

| d | Thickness in Inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ins. | 1/8 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1" |
| 6 | 2 3 | 4 9 | 6.2 | 7 6 | 9 1 | 10 6 | 12.1 | 13 8 | 15 4 | 17 2 | 18 9 | 20 7 | 22.7 | 24.7 |
| 6½ | 2 7 | 5 7 | 7.3 | 8 9 | 10 5 | 12 3 | 14 1 | 15 9 | 17.8 | 19 8 | 21.8 | 23 9 | 26.1 | 28 3 |
| 7 | 3.2 | 6 6 | 8 4 | 10 2 | 12 1 | 14 1 | 16 1 | 18 2 | 20.4 | 22 6 | 24 9 | 27 2 | 29 7 | 32.2 |
| 7½ | 3.6 | 7 5 | 9 5 | 11.6 | 13 8 | 16 0 | 18 3 | 20 7 | 23.1 | 25 6 | 28 2 | 30 8 | 33 5 | 36 3 |
| 8 | 4 1 | 8 5 | 10.8 | 13 2 | 15 6 | 18 1 | 20 6 | 23 3 | 26 0 | 28 8 | 31 6 | 34 6 | 37 6 | 40 7 |
| 8½ | 4 6 | 9 6 | 12.1 | 14 8 | 17.5 | 20 3 | 23.1 | 26.1 | 29.1 | 32.2 | 35 3 | 38 6 | 41 9 | 45.3 |
| 9 | 5 2 | 10 7 | 13.6 | 16 5 | 19.5 | 22 6 | 25.7 | 29 0 | 32 3 | 35.7 | 39 2 | 42 8 | 46 4 | 50.2 |
| 9½ | 5 8 | 11 9 | 15.0 | 18 3 | 21 6 | 25 0 | 28 5 | 32 1 | 35 7 | 39.5 | 43 3 | 47.2 | 51 2 | 55 3 |
| 10 | 6 4 | 13 1 | 16.6 | 20 2 | 23 8 | 27 6 | 31.4 | 35 3 | 39 3 | 43.4 | 47 6 | 51 9 | 56 2 | 60 7 |
| 10½ | 7.1 | 14 5 | 18.3 | 22 2 | 26 2 | 30 3 | 34 5 | 38 7 | 43 1 | 47.5 | 52 1 | 56 7 | 61.5 | 66 3 |
| 12 | 9.2 | 18 8 | 23.7 | 28 7 | 33 9 | 39 1 | 44 2 | 49 8 | 55 4 | 61.0 | 66 8 | 72 6 | 76.8 | 84 7 |
| 12½ | 10 0 | 20 3 | 25.7 | 31.1 | 36.6 | 42 3 | 48 0 | 53 9 | 59 8 | 65.9 | 72 1 | 78.4 | 84 8 | 91 3 |
| 14 | 12.5 | 25.4 | 32.0 | 38 8 | 45.6 | 52 6 | 59 7 | 66 9 | 74 2 | 81.7 | 89 2 | 96 9 | 104.7 | 112.7 |
| 14½ | 13.4 | 27.2 | 34.3 | 41.5 | 48.8 | 56 3 | 63 8 | 71 5 | 79 4 | 87.3 | 95 3 | 103 5 | 111.9 | 120 3 |
| 15 | 14 3 | 29 1 | 36.7 | 44 3 | 52.1 | 60 1 | 68 1 | 76 3 | 84 7 | 93.1 | 101 7 | 110 4 | 119 2 | 128 2 |
| 16 | 16 2 | 33 0 | 41.6 | 50 2 | 59 1 | 68 1 | 77 2 | 86 4 | 95 8 | 105.3 | 114 9 | 124 7 | 134 6 | 144 7 |
| 16½ | 17 3 | 35 1 | 44.2 | 53.4 | 62.8 | 72.3 | 81.9 | 91.7 | 101.6 | 111.7 | 121 9 | 132 2 | 142 7 | 153 3 |
| 18 | 20 5 | 41.6 | 52.4 | 63 3 | 74 4 | 85 6 | 96 9 | 108 4 | 120 1 | 131.9 | 143.9 | 156 0 | 168 2 | 180 7 |
| 18½ | 21 7 | 43 9 | 55.3 | 66 8 | 78 5 | 90 3 | 102 2 | 114 3 | 126 6 | 139.0 | 151 6 | 164 3 | 177 2 | 190 3 |
| 20 | 25.3 | 51 3 | 64.5 | 77 8 | 91 4 | 105 1 | 118 9 | 133 0 | 147 2 | 161.5 | 176 1 | 190 8 | 205 6 | 220.7 |
| 20½ | 26 6 | 53 8 | 67.7 | 81.7 | 95.9 | 110 3 | 124 8 | 139 5 | 154 4 | 169.4 | 184 6 | 200 0 | 215 6 | 231.3 |
| 21 | 27.9 | 56.4 | 71.0 | 85.7 | 100 5 | 115 6 | 130 8 | 146 2 | 161.7 | 177.5 | 193.4 | 209 5 | 225 7 | 242 2 |
| 22 | 30 6 | 61 9 | 77.8 | 93.9 | 110 1 | 126.6 | 143.2 | 160 0 | 177 0 | 194.2 | 211.5 | 229 0 | 246.8 | 264 7 |
| 22½ | 32 0 | 64 7 | 81.3 | 98 1 | 115 1 | 132 3 | 149 6 | 167 2 | 184.9 | 202.8 | 220 9 | 239 2 | 257.6 | 276 3 |
| 24 | 36 4 | 73 5 | 92.4 | 111 4 | 130 6 | 150 1 | 169 7 | 189 5 | 209 6 | 229 8 | 250.2 | 270 8 | 291 6 | 312.7 |
| 24½ | 37 9 | 76 6 | 96 2 | 116 0 | 136 0 | 156 3 | 176 7 | 197 3 | 218 1 | 239 2 | 260 4 | 281 8 | 303.5 | 325 3 |
| 26 | 42.7 | 86 1 | 108.2 | 130 4 | 152 9 | 175 6 | 198 5 | 221 6 | 244 9 | 268 4 | 292.1 | 316.1 | 340 3 | 364.7 |
| 26½ | 44.3 | 89.4 | 112 3 | 135 4 | 158 7 | 182 3 | 206 0 | 230 0 | 254 1 | 278 5 | 303.1 | 328 0 | 353 0 | 378.3 |
| 27 | 46 0 | 92 8 | 116.6 | 140 5 | 164 7 | 189 1 | 213 7 | 238 5 | 263 6 | 288 8 | 314 3 | 340 1 | 366 0 | 392 2 |
| 28 | 49 4 | 99 8 | 125.3 | 151 0 | 176 9 | 203 1 | 229 5 | 256 1 | 283 0 | 310 0 | 337.3 | 364 9 | 392 7 | 420.7 |
| 28½ | 51.2 | 103 3 | 129.7 | 156 3 | 183 2 | 210 3 | 237 6 | 265 1 | 292 9 | 320 9 | 349 2 | 377 6 | 406 3 | 435 3 |
| 30 | 56 7 | 114 4 | 143.6 | 173 0 | 202 7 | 232 6 | 262 7 | 293 1 | 323 8 | 354 7 | 385 8 | 417 2 | 448 8 | 480 7 |
| 30½ | 58 6 | 118 2 | 148.4 | 178 7 | 209 4 | 240 3 | 271.4 | 302 8 | 334 4 | 366 3 | 398.4 | 430 8 | 463.4 | 496.3 |
| 32½ | 66.5 | 134.1 | 168.2 | 202 7 | 237 3 | 272 3 | 307 5 | 342 9 | 378 7 | 414 7 | 450 9 | 487 4 | 524.2 | 561 3 |
| 33 | 68 6 | 138 2 | 173 4 | 208 9 | 244 6 | 280 6 | 316 8 | 353 4 | 390 2 | 427 2 | 464 5 | 502 1 | 540 0 | 578 2 |
| 34½ | 74 9 | 150 9 | 189.4 | 228 1 | 267 0 | 306 3 | 345 8 | 385 6 | 425.7 | 466 0 | 506 7 | 547 6 | 588.8 | 630 3 |
| 36 | 81 6 | 164 3 | 206.0 | 248 1 | 290 4 | 333 1 | 376 0 | 419 2 | 462 7 | 506 5 | 550 6 | 595.0 | 639.7 | 684.7 |
| 36½ | 83 8 | 168 8 | 211.7 | 255 0 | 298 5 | 342 3 | 386 4 | 430 7 | 475.4 | 520 4 | 565 7 | 611 2 | 657.1 | 703.3 |
| 38½ | 93 2 | 187 7 | 235.4 | 283 4 | 331 7 | 380 3 | 429 2 | 478 4 | 527.9 | 577 8 | 627 9 | 678 4 | 729 2 | 780.3 |
| 40½ | 103 1 | 207 6 | 260 3 | 313 3 | 366 6 | 420 3 | 474 3 | 528.6 | 583.2 | 638 2 | 693 4 | 749 1 | 805 0 | 861.3 |
| 42½ | 113 6 | 228 4 | 286.4 | 344 7 | 403 3 | 462 3 | 521 6 | 581 2 | 641.2 | 701 5 | 762 2 | 823 2 | 884 6 | 946.3 |
| 44½ | 124 6 | 250 3 | 313 8 | 377 6 | 441 7 | 506 3 | 571 1 | 636 4 | 702.0 | 767 9 | 834.2 | 900 9 | 967 9 | 1035 3 |
| 46½ | 135 9 | 273 2 | 342.4 | 412.0 | 481 9 | 552 3 | 623 0 | 694 0 | 765.5 | 837.3 | 909 5 | 982.0 | 1055.0 | 1128 3 |
| 48½ | 147 8 | 297 1 | 372.3 | 447 9 | 523 9 | 600 3 | 677 0 | 754 2 | 831 7 | 909 7 | 988 0 | 1066.7 | 1145.8 | 1225 3 |
| 50½ | 160 2 | 321 9 | 403 4 | 485 3 | 567 6 | 650 3 | 733 4 | 816 8 | 900 7 | 985 0 | 1069 7 | 1154 8 | 1240 4 | 1326 3 |
| 52½ | 173 1 | 347 8 | 435.8 | 524 2 | 613 0 | 702 3 | 791 9 | 882 0 | 972.5 | 1063 4 | 1154 7 | 1246 5 | 1338 7 | 1431 3 |
| 54½ | 186 5 | 374 7 | 469 4 | 564 6 | 660 2 | 756 3 | 852 7 | 949 7 | 1047.0 | 1144 8 | 1243 0 | 1341 7 | 1440 8 | 1540 3 |
| 56½ | 200 4 | 402 6 | 504.3 | 606 5 | 709 2 | 812 3 | 915 8 | 1019 8 | 1124.3 | 1229 2 | 1334 5 | 1440 3 | 1546 6 | 1653 3 |
| 58½ | 214 8 | 431 4 | 540 5 | 649 9 | 759.9 | 870 3 | 981 1 | 1092 5 | 1204.3 | 1316 5 | 1429.3 | 1542 5 | 1656.1 | 1770 3 |
| 60½ | 229 7 | 461 3 | 577.8 | 694 8 | 812 3 | 930 3 | 1048 7 | 1167 6 | 1287.0 | 1406 9 | 1527.3 | 1648 1 | 1769 5 | 1891 3 |
| 62½ | 245 1 | 492 2 | 616.5 | 741 2 | 866 5 | 992 3 | 1118 5 | 1245 3 | 1372.5 | 1500 3 | 1628 5 | 1757 3 | 1886 5 | 2016 3 |
| 64½ | 261 0 | 524 1 | 656 4 | 789 1 | 922 4 | 1056 3 | 1190 6 | 1325 4 | 1460.8 | 1596 7 | 1733 0 | 1869 9 | 2007 4 | 2145 3 |
| 66½ | 277 4 | 556 9 | 697 5 | 838 6 | 980 1 | 1122 3 | 1264 9 | 1408 1 | 1551.8 | 1696 0 | 1840.8 | 1986 1 | 2131 9 | 2278 3 |
| 68½ | 294 3 | 590 8 | 739 9 | 889 5 | 1039 6 | 1190 3 | 1341 5 | 1493 2 | 1645.6 | 1798 4 | 1951.8 | 2105.7 | 2260 2 | 2415 3 |
| 70½ | 311 7 | 625 7 | 783.5 | 941 9 | 1100 8 | 1260 3 | 1420 3 | 1580 9 | 1742 1 | 1903.8 | 2066.1 | 2228 9 | 2392 3 | 2556.3 |
| 72½ | 329 6 | 661 6 | 828.4 | 995 8 | 1163 7 | 1332 3 | 1501 4 | 1671 1 | 1841.3 | 2012 2 | 2183 6 | 2355.5 | 2528 1 | 2701.3 |
| 74½ | 348 0 | 698 4 | 874 5 | 1051 2 | 1228 4 | 1406 3 | 1584 7 | 1763 7 | 1943.3 | 2123 5 | 2304 3 | 2485.7 | 2667 7 | 2850 3 |
| 76½ | 367 0 | 736 3 | 921 9 | 1108 1 | 1294 9 | 1482 3 | 1670 3 | 1858 9 | 2048.1 | 2237 9 | 2428 3 | 2619 4 | 2811 0 | 3003.3 |
| 78½ | 386 4 | 775 2 | 970 5 | 1166 5 | 1363 1 | 1560 3 | 1758 1 | 1956 5 | 2155.6 | 2355 3 | 2555.6 | 2756 5 | 2958 1 | 3160 3 |
| 80½ | 406 3 | 815 1 | 1020 4 | 1226 4 | 1433 0 | 1640 3 | 1848 2 | 2056 7 | 2265.9 | 2475 7 | 2686.1 | 2897 2 | 3108 9 | 3321.3 |
| 82½ | 426 7 | 855 9 | 1071.6 | 1287 8 | 1504 7 | 1722 3 | 1940 5 | 2159.3 | 2378.9 | 2599 0 | 2819 9 | 3041 3 | 3263.5 | 3486 3 |
| 84½ | 447 6 | 897 8 | 1123 9 | 1350 7 | 1578 1 | 1806 3 | 2035 0 | 2264 5 | 2494.6 | 2725 4 | 2956 9 | 3189 0 | 3421 8 | 3655 3 |
| 90½ | 513 3 | 1029 4 | 1288 6 | 1548 4 | 1809 0 | 2070 3 | 2332 3 | 2595 0 | 2858.4 | 3122 5 | 3387 4 | 3653 0 | 3919 3 | 4186.3 |
| 96½ | 583 5 | 1170 1 | 1464 5 | 1759.6 | 2055 6 | 2352 3 | 2649 7 | 2947 9 | 3246.9 | 3546 7 | 3847.2 | 4148 4 | 4450.5 | 4753 3 |
| 102½ | 658 2 | 1319 7 | 1651 6 | 1984.4 | 2317 9 | 2652 3 | 2987 4 | 3323 4 | 3660.2 | 3997 8 | 4336 2 | 4675 4 | 5015 4 | 5356.3 |
| 108½ | 737 5 | 1478 3 | 1850 0 | 2222 6 | 2596 0 | 2970 3 | 3345 4 | 3721 4 | 4098.2 | 4475.9 | 4854 5 | 5233 9 | 5614.1 | 5995.3 |
| 114½ | 821 2 | 1645 9 | 2059.7 | 2474.3 | 2889.8 | 3306 3 | 3723 6 | 4141.8 | 4561.0 | 4981 0 | 5402 0 | 5823 8 | 6246.6 | 6670 3 |
| 120½ | 909 4 | 1822 6 | 2280 6 | 2739.5 | 3199.4 | 3660 3 | 4122 1 | 4584 8 | 5048.5 | 5513 2 | 5978 8 | 6445 3 | 6912 8 | 7381 3 |

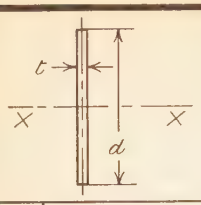
# MOMENTS OF INERTIA OF TWO PLATES




Moments of Inertia of Two Plates ONE INCH WIDE About Axis X—X
Depths measured between Plates.

To obtain the Moment of Inertia of two plates of any desired width multiply the Tabular Value given for the correct thickness and depth between plates by the net width.

| d | Thickness in Inches | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ins. | 1⅛ | 1¼ | 1⅜ | 1½ | 1⅝ | 1¾ | 1⅞ | 2 | 2¼ | 2½ | 2¾ | 3 | 3½ | 4 |
| 6 | 28.8 | 33.2 | 37.8 | 42.8 | | | | | | | | | | |
| 6½ | 32.9 | 37 9 | 43.1 | 48.6 | | | | | | | | | | |
| 7 | 37.4 | 42.9 | 48 7 | 54.8 | | | | | | | | | | |
| 7½ | 42 1 | 48 2 | 54 6 | 61.3 | | | | | | | | | | |
| 8 | 47.1 | 53 8 | 60 9 | 68.3 | | | | | | | | | | |
| 8½ | 52.3 | 59.7 | 67.5 | 75.6 | | | | | | | | | | |
| 9 | 57.9 | 66 0 | 74.4 | 83.3 | 92 4 | 102 0 | | | | | | | | |
| 9½ | 63 7 | 72 6 | 81.7 | 91.3 | 101 3 | 111.6 | | | | | | | | |
| 10 | 69 9 | 79 4 | 89 4 | 99.8 | 110 5 | 121 7 | | | | | | | | |
| 10½ | 76.3 | 86 6 | 97 4 | 108.6 | 120 2 | 132 2 | | | | | | | | |
| 12 | 97.1 | 110 1 | 123 4 | 137.3 | 151 5 | 166 3 | 181.6 | 197.3 | | | | | | |
| 12½ | 104.7 | 118.5 | 132.8 | 147.6 | 162 8 | 178 6 | 194.8 | 211.6 | | | | | | |
| 14 | 128.9 | 145 7 | 163 0 | 180.8 | 199 1 | 217 9 | 237.4 | 257.3 | 299.0 | 342.9 | 389.2 | 438.0 | | |
| 14½ | 137.6 | 155 4 | 173 7 | 192.6 | 212 0 | 231 9 | 252.5 | 273.6 | 317.5 | 363.9 | 412.6 | 463 9 | | |
| 15 | 146.5 | 165 4 | 184 8 | 204.8 | 225 3 | 246 4 | 268.1 | 290.3 | 336.7 | 385.4 | 436 7 | 490 5 | 606.1 | 732.7 |
| 16 | 165.2 | 186 3 | 208 0 | 230.3 | 253 1 | 276 6 | 300.6 | 325.3 | 376.6 | 430.4 | 486 9 | 546 0 | 672.6 | 810.7 |
| 16½ | 175 0 | 197.2 | 220 1 | 243.6 | 267 6 | 292 3 | 317.6 | 343.6 | 397.4 | 453.9 | 513.0 | 574 9 | 707.1 | 851.2 |
| 18 | 206.0 | 231.9 | 258.5 | 285.8 | 313 6 | 342 2 | 371.4 | 401.3 | 463.2 | 527.9 | 595.5 | 666.0 | 816.1 | 978.7 |
| 18½ | 216.9 | 244 1 | 272 0 | 300.6 | 329 8 | 359 7 | 390.3 | 421.6 | 486.3 | 553.9 | 624.4 | 697.9 | 854.1 | 1023.2 |
| 20 | 251 3 | 282 6 | 314 5 | 347.3 | 380 7 | 414 8 | 449.7 | 485.3 | 558.9 | 635.4 | 715.1 | 798 0 | 973.6 | 1162.7 |
| 20½ | 263.3 | 296 0 | 329 4 | 363.6 | 398 4 | 434 1 | 470.4 | 507.6 | 584.2 | 663.9 | 746 7 | 832 9 | 1015.1 | 1211.2 |
| 21 | 275.6 | 309.7 | 344 6 | 380.3 | 416 6 | 453 8 | 491.7 | 530.3 | 610.0 | 692.9 | 779.1 | 868.5 | 1057 6 | 1260.7 |
| 22 | 301.0 | 338 2 | 376.1 | 414.8 | 454 2 | 494.4 | 535.5 | 577.3 | 663.5 | 752.9 | 845.7 | 942 0 | 1145.1 | 1362.7 |
| 22½ | 314.2 | 352 9 | 392 3 | 432.6 | 473 6 | 515.4 | 558.1 | 601.6 | 691.0 | 783.9 | 880.1 | 979 9 | 1190.1 | 1415.2 |
| 24 | 355.3 | 398 8 | 443 1 | 488.3 | 534 2 | 581.1 | 628.8 | 677.3 | 777.1 | 880.4 | 987.4 | 1098 0 | 1330.6 | 1578.7 |
| 24½ | 369.6 | 414 7 | 460 7 | 507.6 | 555 3 | 603.8 | 653.3 | 703.6 | 806.9 | 913.9 | 1024 5 | 1138.9 | 1379 1 | 1635.2 |
| 26 | 414.1 | 464 4 | 515 6 | 567.8 | 620 7 | 674.7 | 729.6 | 785.3 | 899.7 | 1017.9 | 1140.0 | 1266.0 | 1530.1 | 1810.7 |
| 26½ | 429 5 | 481.6 | 534 6 | 588.6 | 643 4 | 699.2 | 755.9 | 813.6 | 931 8 | 1053.9 | 1180.0 | 1309.9 | 1582.1 | 1871.2 |
| 27 | 445.2 | 499 1 | 554 0 | 609.8 | 666 5 | 724.1 | 782.8 | 842.3 | 964.4 | 1090.4 | 1220.4 | 1354.5 | 1635.1 | 1932.7 |
| 28 | 477 4 | 535 1 | 593 7 | 653.3 | 713 8 | 775.3 | 837.8 | 901.3 | 1031 3 | 1165.4 | 1303 6 | 1446 0 | 1743 6 | 2058 7 |
| 28½ | 493 9 | 553 5 | 614 0 | 675.6 | 738 1 | 801.6 | 866.1 | 931.6 | 1065 7 | 1203.9 | 1346 2 | 1492 9 | 1799.1 | 2123.2 |
| 30 | 545 2 | 610 7 | 677 2 | 744.8 | 813 3 | 882.9 | 953.6 | 1025.3 | 1172 0 | 1322.9 | 1478 2 | 1638 0 | 1971.1 | 2322 7 |
| 30½ | 562.8 | 630.4 | 698.9 | 768.6 | 839 2 | 910.9 | 983.7 | 1057.6 | 1208 5 | 1363.9 | 1523 6 | 1687 9 | 2030.1 | 2391.2 |
| 32½ | 636.2 | 712 2 | 789 4 | 867.6 | 946.9 | 1027.3 | 1108.9 | 1191.6 | 1360 4 | 1533.9 | 1712 0 | 1894.9 | 2275.1 | 2675 2 |
| 33 | 655.3 | 733 5 | 812 8 | 893.3 | 974 8 | 1057.5 | 1141.3 | 1226.3 | 1399 8 | 1577.9 | 1760.8 | 1948.5 | 2338.6 | 2748.7 |
| 34½ | 714 1 | 799 1 | 885 3 | 972.6 | 1061 0 | 1150.7 | 1241.5 | 1333.6 | 1521 3 | 1713.9 | 1911 4 | 2113.9 | 2534.1 | 2975 2 |
| 36 | 775.5 | 867 6 | 960 8 | 1055.3 | 1150 9 | 1247.8 | 1346.0 | 1445.3 | 1647.8 | 1855.4 | 2068.1 | 2286.0 | 2737.6 | 3210 7 |
| 36½ | 796 5 | 891 0 | 986 7 | 1083.6 | 1181 7 | 1281.1 | 1381.7 | 1483 6 | 1691 2 | 1903.9 | 2121.7 | 2344 9 | 2807 1 | 3291 2 |
| 38½ | 883 4 | 987.9 | 1093 6 | 1200 6 | 1308 9 | 1418 4 | 1529.4 | 1641.6 | 1870 0 | 2103.9 | 2343.1 | 2587.9 | 3094.1 | 3623 2 |
| 40½ | 974 8 | 1089 7 | 1206 0 | 1323.6 | 1442 5 | 1562 8 | 1684.5 | 1807.6 | 2057 9 | 2313.9 | 2575.5 | 2842.9 | 3395.1 | 3971 2 |
| 42½ | 1070 8 | 1196 6 | 1323 9 | 1452.6 | 1582 7 | 1714 2 | 1847.2 | 1981.6 | 2251 8 | 2533.9 | 2818 9 | 3109.9 | 3710.1 | 4335 2 |
| 44½ | 1171 2 | 1308 5 | 1447 3 | 1587.6 | 1729 3 | 1872 6 | 2017.3 | 2163.6 | 2460 7 | 2763.9 | 3073 2 | 3388.9 | 4039 1 | 4715 2 |
| 46½ | 1276 1 | 1425 4 | 1576.2 | 1728.6 | 1882.5 | 2037 9 | 2195.0 | 2353.6 | 2675 5 | 3003.9 | 3338 6 | 3679.9 | 4382 1 | 5111.2 |
| 48½ | 1385 5 | 1547 2 | 1710 6 | 1875.6 | 2042.1 | 2210 3 | 2380.1 | 2551.6 | 2899.4 | 3253.9 | 3615 0 | 3982 9 | 4739 1 | 5523 2 |
| 50½ | 1499 4 | 1674 1 | 1850 5 | 2028.6 | 2208.3 | 2389 7 | 2572.8 | 2757.6 | 3132 3 | 3513.9 | 3902.4 | 4297.9 | 5110.1 | 5951 2 |
| 52½ | 1617 8 | 1806 0 | 1995 9 | 2187.6 | 2380 9 | 2576 1 | 2772.9 | 2971 6 | 3374 2 | 3783.9 | 4200 7 | 4624.9 | 5495 1 | 6395 2 |
| 54½ | 1740 7 | 1942 9 | 2146 8 | 2352.6 | 2560 1 | 2769 4 | 2980.6 | 3193 6 | 3625.0 | 4063.9 | 4510.1 | 4963 9 | 5894.1 | 6855 2 |
| 56½ | 1868 1 | 2084 7 | 2303 2 | 2523.6 | 2745 8 | 2969 8 | 3195.8 | 3423.6 | 3884.9 | 4353.9 | 4830.5 | 5314.9 | 6307.1 | 7331 2 |
| 58½ | 2000 0 | 2231 6 | 2465 1 | 2700.6 | 2937.9 | 3177 2 | 3418.4 | 3661.6 | 4153.8 | 4653.9 | 5161.9 | 5677.9 | 6734.1 | 7823.2 |
| 60½ | 2136 4 | 2383 5 | 2632 5 | 2883.6 | 3136.6 | 3391 6 | 3648.6 | 3907.6 | 4431.7 | 4963.9 | 5504.2 | 6052.9 | 7175.1 | 8331 2 |
| 62½ | 2277 3 | 2540 4 | 2805 4 | 3072.6 | 3341.7 | 3612 9 | 3886.2 | 4161.6 | 4718.5 | 5283.9 | 5857.6 | 6439.9 | 7630.1 | 8855.2 |
| 64½ | 2422 7 | 2702 2 | 2983 9 | 3267.6 | 3553.4 | 3841 3 | 4131 4 | 4423.6 | 5014.4 | 5613.9 | 6222.0 | 6838.9 | 8099.1 | 9395 2 |
| 66½ | 2572 6 | 2869 1 | 3167 8 | 3468.6 | 3771.5 | 4076 7 | 4384 0 | 4693.6 | 5319 3 | 5953 9 | 6597.4 | 7249.9 | 8582.1 | 9951 2 |
| 68½ | 2727 0 | 3041 0 | 3357 2 | 3675.6 | 3996.2 | 4319 1 | 4644 2 | 4971 6 | 5633.2 | 6303.9 | 6983.7 | 7672 9 | 9079 1 | 10523 |
| 70½ | 2885 9 | 3217 9 | 3552.1 | 3888.6 | 4227.4 | 4568 4 | 4911 9 | 5257.6 | 5956.0 | 6663 9 | 7381.1 | 8107.9 | 9590.1 | 11111 |
| 72½ | 3049 3 | 3399 7 | 3752 5 | 4107 6 | 4465.0 | 4824 8 | 5187.0 | 5551.6 | 6287 9 | 7033 9 | 7789.5 | 8554.9 | 10115 | 11715 |
| 74½ | 3217 3 | 3586 6 | 3958 4 | 4332.6 | 4709 2 | 5088 2 | 5469.7 | 5853.6 | 6628 8 | 7413 9 | 8208 9 | 9013.9 | 10654 | 12335 |
| 76½ | 3389 7 | 3778 5 | 4169 8 | 4563.6 | 4959.8 | 5358 6 | 5759.8 | 6163 6 | 6978.7 | 7803 9 | 8639 2 | 9484 9 | 11207 | 12971 |
| 78½ | 3566 6 | 3975 4 | 4386 7 | 4800.6 | 5217.0 | 5635 9 | 6057.5 | 6481.6 | 7337.5 | 8203 9 | 9080 6 | 9967.9 | 11774 | 13623 |
| 80½ | 3748 0 | 4177 2 | 4609 1 | 5043.6 | 5480.6 | 5920 3 | 6362.6 | 6807.6 | 7705.4 | 8613.9 | 9533 0 | 10463 | 12355 | 14291 |
| 82½ | 3933 9 | 4384.1 | 4837.0 | 5292 6 | 5750.8 | 6211.7 | 6675 3 | 7141.6 | 8082.3 | 9033.9 | 9996.4 | 10970 | 12950 | 14975 |
| 84½ | 4124 3 | 4596 0 | 5070.4 | 5547.6 | 6027.4 | 6510 1 | 6995.4 | 7483.6 | 8468.2 | 9463 9 | 10471 | 11489 | 13559 | 15675 |
| 90½ | 4722 5 | 5261 6 | 5803 6 | 6348 6 | 6896.4 | 7447.2 | 8000.9 | 8557.6 | 9679.8 | 10814 | 11960 | 13118 | 15470 | 17871 |
| 96½ | 5361 2 | 5972 2 | 6586 4 | 7203.6 | 7823.9 | 8447.3 | 9073.9 | 9703.6 | 10972 | 12254 | 13548 | 14855 | 17507 | 20211 |
| 102½ | 6040 4 | 6727 9 | 7418 6 | 8112.6 | 8809.9 | 9510.4 | 10214 | 10922 | 12346 | 13784 | 15235 | 16700 | 19670 | 22695 |
| 108½ | 6760 2 | 7528.5 | 8300 3 | 9075.6 | 9854.3 | 10637 | 11422 | 12212 | 13801 | 15404 | 17021 | 18653 | 21959 | 25323 |
| 114½ | 7520 4 | 8374 1 | 9231 5 | 10093 | 10957 | 11826 | 12698 | 13574 | 15336 | 17114 | 18906 | 20714 | 24374 | 28095 |
| 120½ | 8321.1 | 9264 7 | 10212 | 11164 | 12119 | 13078 | 14041 | 15008 | 16953 | 18914 | 20890 | 22883 | 26915 | 31011 |



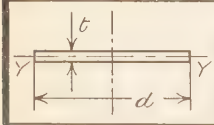

# MOMENTS OF INERTIA OF ONE PLATE

## MOMENT OF INERTIA OF ONE PLATE ABOUT AXIS X - X

Various depths and thicknesses
as used for Web Plates for built up Columns or Girders.

To obtain the Moment of Inertia for any thickness of Plate not listed below, multiply the Tabular Value given for the correct depth and one inch thick by the desired thickness.

| d | Thickness in Inches | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ins. | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 6 | 4 5 | 5.6 | 6 7 | 7.9 | 9 0 | 10.1 | 11 2 | 12 4 | 13.5 | 14.6 | 15.7 | 16 9 | 18.0 |
| 7 | 7.1 | 8.9 | 10 7 | 12.5 | 14 3 | 16.1 | 17 9 | 19.7 | 21.4 | 23.2 | 25.0 | 26.8 | 28.6 |
| 8 | 10.7 | 13.3 | 16 0 | 18.7 | 21 3 | 24 0 | 26 7 | 29 3 | 32.0 | 34.7 | 37.3 | 40.0 | 42.7 |
| 9 | 15.2 | 19.0 | 22.8 | 26.6 | 30 4 | 34 2 | 38 0 | 41.8 | 45.6 | 49.4 | 53.2 | 57.0 | 60.7 |
| 10 | 20.8 | 26 0 | 31 2 | 36.5 | 41 7 | 46.9 | 52.1 | 57 3 | 62.5 | 67.7 | 72.9 | 78.1 | 83.3 |
| 12 | 36.0 | 45.0 | 54 0 | 63.0 | 72 0 | 81.0 | 90 0 | 99 0 | 108.0 | 117.0 | 126.0 | 135.0 | 144.0 |
| 14 | 57.2 | 71 5 | 85 7 | 100.0 | 114 3 | 128.6 | 142 9 | 157 2 | 171.5 | 185.8 | 200.1 | 214.4 | 228.7 |
| 16 | 85.3 | 106.7 | 128 0 | 149.3 | 170 7 | 192 0 | 213 3 | 234.7 | 256.0 | 277.3 | 298.7 | 320.0 | 341.3 |
| 18 | 121.5 | 151.9 | 182.2 | 212.6 | 243 0 | 273.4 | 303 7 | 334.1 | 364.5 | 394.9 | 425.2 | 455.6 | 486.0 |
| 20 | 166.7 | 208.3 | 250.0 | 291.7 | 333 3 | 375.0 | 416 7 | 458.3 | 500.0 | 541.7 | 583.3 | 625 0 | 666.7 |
| 22 | 221.8 | 277 3 | 332.7 | 388.2 | 443 7 | 499.1 | 554 6 | 610.0 | 665.5 | 721.0 | 776.4 | 831.9 | 887.3 |
| 24 | 288.0 | 360.0 | 432.0 | 504.0 | 576 0 | 648.0 | 720 0 | 792.0 | 864.0 | 936.0 | 1008.0 | 1080.0 | 1152.0 |
| 26 | 366.2 | 457.7 | 549.2 | 640.8 | 732 3 | 823.9 | 915 4 | 1007.0 | 1098.5 | 1190.0 | 1281.6 | 1373.1 | 1464.7 |
| 28 | 457.3 | 571.7 | 686.0 | 800.3 | 914 7 | 1029.0 | 1143.3 | 1257.7 | 1372.0 | 1486.3 | 1600.7 | 1715.0 | 1829.3 |
| 30 | 562.5 | 703.1 | 843.7 | 984.4 | 1125 0 | 1265.6 | 1406 2 | 1546.9 | 1687.5 | 1828.1 | 1968.7 | 2109.4 | 2250.0 |
| 32 | 682.7 | 853.3 | 1024.0 | 1194.7 | 1365 3 | 1536.0 | 1706 7 | 1877.3 | 2048.0 | 2218.7 | 2389.3 | 2560.0 | 2730.6 |
| 34 | 818.8 | 1023.5 | 1228.2 | 1432.9 | 1637 7 | 1842.4 | 2047.1 | 2251.8 | 2456.5 | 2661.2 | 2865.9 | 3070 6 | 3275.3 |
| 36 | 972.0 | 1215.0 | 1458.0 | 1701.0 | 1944 0 | 2187.0 | 2430.0 | 2673.0 | 2916.0 | 3159.0 | 3402.0 | 3645.0 | 3888.0 |
| 38 | 1143.2 | 1429.0 | 1714.7 | 2000.5 | 2286 3 | 2572.1 | 2857.9 | 3143.7 | 3429.5 | 3715.3 | 4001.1 | 4286 9 | 4572.7 |
| 40 | 1333.3 | 1666.7 | 2000.0 | 2333.3 | 2666 7 | 3000.0 | 3333.3 | 3666.7 | 4000.0 | 4333.3 | 4666.7 | 5000.0 | 5333.3 |
| 42 | 1543.5 | 1929.4 | 2315.2 | 2701.1 | 3087 0 | 3472.9 | 3858 7 | 4244.6 | 4630.5 | 5016.4 | 5402.2 | 5788.1 | 6174.0 |
| 44 | 1774.7 | 2218.3 | 2662.0 | 3105.7 | 3549 3 | 3993.0 | 4436 7 | 4880.3 | 5324.0 | 5767.7 | 6211.3 | 6655.0 | 7098.7 |
| 46 | 2027.8 | 2534.8 | 3041.7 | 3548.7 | 4055.7 | 4562.6 | 5069 6 | 5576.5 | 6083.5 | 6590.5 | 7097.4 | 7604.4 | 8111.3 |
| 48 | 2304.0 | 2880.0 | 3456.0 | 4032.0 | 4608 0 | 5184.0 | 5760 0 | 6336.0 | 6912.0 | 7488.0 | 8064.0 | 8640.0 | 9216.0 |
| 50 | 2604.2 | 3255.2 | 3906 2 | 4557.3 | 5208 3 | 5859.4 | 6510 4 | 7161.5 | 7812.5 | 8463.5 | 9114.6 | 9765 6 | 10417 |
| 52 | 2929.3 | 3661.7 | 4394 0 | 5126.3 | 5858 7 | 6591.0 | 7323.3 | 8055.7 | 8788.0 | 9520.3 | 10253 | 10985 | 11717 |
| 54 | 3280.4 | 4100.6 | 4920 7 | 5740.9 | 6561 0 | 7381.1 | 8201.2 | 9021.4 | 9841.5 | 10662 | 11482 | 12302 | 13122 |
| 56 | 3658.7 | 4573.3 | 5488 0 | 6402.7 | 7317 3 | 8232.0 | 9146 7 | 10061 | 10976 | 11891 | 12805 | 13720 | 14635 |
| 58 | 4064.8 | 5081 0 | 6097.2 | 7113.5 | 8129.7 | 9145.9 | 10162 | 11178 | 12194 | 13211 | 14227 | 15243 | 16259 |
| 60 | 4500.0 | 5625.0 | 6750 0 | 7875.0 | 9000.0 | 10125 | 11250 | 12375 | 13500 | 14625 | 15750 | 16875 | 18000 |
| 62 | 4965.2 | 6206 5 | 7447 7 | 8689.0 | 9930 3 | 11172 | 12413 | 13654 | 14895 | 16137 | 17378 | 18619 | 19861 |
| 64 | 5461.3 | 6826.7 | 8192 0 | 9557.3 | 10923 | 12288 | 13653 | 15019 | 16384 | 17749 | 19115 | 20480 | 21845 |
| 66 | 5989.5 | 7486.9 | 8984.2 | 10482 | 11979 | 13476 | 14974 | 16471 | 17968 | 19466 | 20963 | 22461 | 23958 |
| 68 | 6550.7 | 8188.3 | 9826 0 | 11464 | 13101 | 14739 | 16377 | 18014 | 19652 | 21290 | 22927 | 24565 | 26203 |
| 70 | 7145.8 | 8932.3 | 10719 | 12505 | 14292 | 16078 | 17865 | 19651 | 21437 | 23224 | 25010 | 26797 | 28583 |
| 72 | 7776.0 | 9720.0 | 11664 | 13608 | 15552 | 17496 | 19440 | 21384 | 23328 | 25272 | 27216 | 29160 | 31104 |
| 74 | 8442.2 | 10553 | 12663 | 14774 | 16884 | 18995 | 21105 | 23216 | 25326 | 27437 | 29548 | 31658 | 33769 |
| 76 | 9145.3 | 11432 | 13718 | 16004 | 18291 | 20577 | 22863 | 25150 | 27436 | 29722 | 32009 | 34295 | 36581 |
| 78 | 9886.5 | 12358 | 14830 | 17301 | 19773 | 22245 | 24716 | 27188 | 29659 | 32131 | 34603 | 37074 | 39546 |
| 80 | 10667 | 13333 | 16000 | 18667 | 21333 | 24000 | 26667 | 29333 | 32000 | 34667 | 37333 | 40000 | 42667 |
| 82 | 11487 | 14359 | 17230 | 20102 | 22974 | 25845 | 28717 | 31589 | 34460 | 37332 | 40204 | 43076 | 45947 |
| 84 | 12348 | 15435 | 18522 | 21609 | 24696 | 27783 | 30870 | 33957 | 37044 | 40131 | 43218 | 46305 | 49392 |
| 90 | 15187 | 18984 | 22781 | 26578 | 30375 | 34172 | 37969 | 41766 | 45562 | 49359 | 53156 | 56953 | 60750 |
| 96 | 18432 | 23040 | 27648 | 32256 | 36864 | 41472 | 46080 | 50688 | 55296 | 59904 | 64512 | 69120 | 73728 |
| 102 | 22108 | 27636 | 33163 | 38690 | 44217 | 49744 | 55271 | 60798 | 66325 | 71853 | 77380 | 82907 | 88434 |
| 108 | 26244 | 32805 | 39366 | 45927 | 52488 | 59049 | 65610 | 72171 | 78732 | 85293 | 91854 | 98415 | 104976 |
| 114 | 30865 | 38582 | 46298 | 54015 | 61731 | 69447 | 77164 | 84880 | 92596 | 100313 | 108029 | 115746 | 123462 |
| 120 | 36000 | 45000 | 54000 | 63000 | 72000 | 81000 | 90000 | 99000 | 108000 | 117000 | 126000 | 135000 | 144000 |

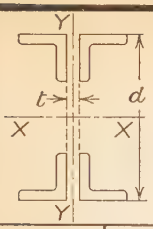



## MOMENT OF INERTIA OF ONE PLATE ONE INCH DEEP ABOUT AXIS Y - Y

Various thicknesses as used for Web Plates for built up Columns and Girders.

To obtain the Moment of Inertia of any depth of Plate multiply the Tabular Value given for the correct thickness by the depth desired.

| d | Thickness in Inches. t'' | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ins. | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1'' |
| 1 | .00130 | .00254 | .00439 | .00698 | .01041 | .01483 | .02034 | .02708 | .03516 | .04469 | .05583 | .06866 | .08333 |




# MOMENTS OF INERTIA OF FOUR ANGLES

## EQUAL LEG ANGLES

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 2 ½″ × 2 ½″ | | | | |
|---|---|---|---|---|---|---|
| Thickness | | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 |
| 4 L's | Area | 2 44 | 3.60 | 4 76 | 5.88 | 6 92 |
| | Weight | 8.32 | 12.28 | 16.4 | 20.0 | 23.6 |
| d″ | | I Axis X - X | | | | |
| 6 ½ | | 18 | 26 | 33 | 40 | 47 |
| 7 ½ | | 25 | 36 | 46 | 57 | 66 |
| 8 ½ | | 33 | 48 | 62 | 76 | 88 |
| 9 ½ | | 42 | 62 | 80 | 98 | 114 |
| 10 ½ | | 53 | 77 | 100 | 123 | 143 |
| 12 ½ | | 77 | 113 | 148 | 182 | 216 |
| 14 ½ | | 107 | 157 | 206 | 253 | 295 |
| 16 ½ | | 142 | 208 | 273 | 335 | 392 |
| 18 ½ | | 181 | 266 | 349 | 429 | 503 |
| 20 ½ | | 225 | 331 | 435 | 535 | 627 |
| 22 ½ | | 275 | 404 | 531 | 653 | 765 |
| 24 ½ | | 329 | 483 | 636 | 782 | 917 |
| t″ | | I Axis Y - Y | | | | |
| 0″ | | 2.6 | 3.9 | 5.3 | 6.6 | 7.9 |
| 1/4 | | 3.1 | 4.6 | 6.2 | 7.8 | 9.3 |
| 5/16 | | 3.2 | 4.8 | 6.5 | 8.1 | 9.7 |
| 3/8 | | 3.3 | 5.0 | 6.7 | 8.5 | 10.1 |
| 7/16 | | 3.4 | 5.2 | 7 0 | 8.8 | 10.5 |
| 1/2 | | 3.6 | 5.4 | 7.3 | 9.2 | 11.0 |
| 9/16 | | 3.7 | 5.6 | 7.6 | 9.5 | 11.4 |
| 5/8 | | 3.9 | 5.8 | 7.9 | 9.9 | 11.9 |
| 3/4 | | 4.2 | 6.3 | 8.5 | 10.7 | 12 8 |

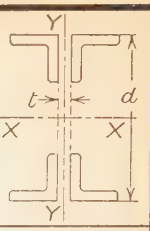
| Size | | 3″ × 3″ | | | | |
|---|---|---|---|---|---|---|
| Thickness | | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 |
| 4 L's | Area | 5.76 | 7.12 | 8 44 | 9.72 | 11.00 |
| | Weight | 19.6 | 24.4 | 28 8 | 33 2 | 37.6 |
| d″ | | I Axis X - X | | | | |
| 6 ½ | | 38 | 46 | 54 | 61 | 68 |
| 7 ½ | | 54 | 65 | 76 | 86 | 96 |
| 8 ½ | | 72 | 87 | 102 | 116 | 130 |
| 9 ½ | | 93 | 113 | 134 | 151 | 169 |
| 10 ½ | | 117 | 143 | 167 | 191 | 214 |
| 12 ½ | | 174 | 212 | 250 | 285 | 320 |
| 14 ½ | | 242 | 296 | 348 | 399 | 448 |
| 16 ½ | | 321 | 394 | 464 | 532 | 598 |
| 18 ½ | | 412 | 506 | 597 | 684 | 770 |
| 20 ½ | | 515 | 632 | 746 | 856 | 964 |
| 22 ½ | | 629 | 773 | 913 | 1047 | 1180 |
| 24 ½ | | 755 | 928 | 1096 | 1258 | 1418 |
| t″ | | I Axis Y - Y | | | | |
| 0″ | | 9.0 | 11.4 | 13.7 | 16 0 | 18.4 |
| 1/4 | | 10.3 | 13.1 | 15.7 | 18.4 | 21.1 |
| 5/16 | | 10.7 | 13.5 | 16.3 | 19.0 | 21.9 |
| 3/8 | | 11.0 | 14.0 | 16.8 | 19.7 | 22.6 |
| 7/16 | | 11.4 | 14.5 | 17.4 | 20.3 | 23.4 |
| 1/2 | | 11.8 | 15.0 | 18.0 | 21.0 | 24.2 |
| 9/16 | | 12.2 | 15.5 | 18.6 | 21.8 | 25.0 |
| 5/8 | | 12.6 | 16.0 | 19.2 | 22.5 | 25.9 |
| 3/4 | | 13.5 | 17.1 | 20.6 | 24.0 | 27.6 |

# MOMENTS OF INERTIA OF FOUR ANGLES

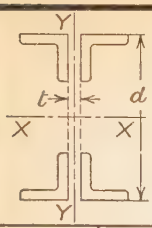
## EQUAL LEG ANGLES

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 3 ½" × 3 ½" | | | | | |
|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | ½ | 9/16 | 5/8 |
| 4 | Area | 8.36 | 9.92 | 11.48 | 13.00 | 14.48 | 15.92 |
| L's | Weight | 28.8 | 34.0 | 39.2 | 44.4 | 49.6 | 54.4 |
| d" | | I Axis X - X | | | | | |
| 7 ½ | | 73 | 86 | 97 | 109 | 119 | 129 |
| 8 ½ | | 99 | 116 | 131 | 147 | 161 | 175 |
| 9 ½ | | 128 | 150 | 171 | 192 | 211 | 229 |
| 10 ½ | | 162 | 190 | 217 | 243 | 267 | 291 |
| 12 ½ | | 241 | 284 | 325 | 365 | 403 | 440 |
| 14 ½ | | 337 | 398 | 456 | 513 | 567 | 619 |
| 16 ½ | | 450 | 532 | 609 | 687 | 760 | 831 |
| 18 ½ | | 580 | 685 | 787 | 887 | 982 | 1075 |
| 20 ½ | | 727 | 858 | 987 | 1112 | 1234 | 1350 |
| 22 ½ | | 890 | 1052 | 1210 | 1364 | 1514 | 1657 |
| 24 ½ | | 1070 | 1265 | 1456 | 1642 | 1823 | 1997 |
| 26 ½ | | 1266 | 1498 | 1725 | 1946 | 2161 | 2367 |
| 28 ½ | | 1480 | 1750 | 2016 | 2276 | 2528 | 2770 |
| 30 ½ | | 1710 | 2023 | 2331 | 2632 | 2923 | 3205 |
| 32 ½ | | 1957 | 2315 | 2669 | 3014 | 3348 | 3671 |
| 34 ½ | | 2220 | 2628 | 3030 | 3422 | 3802 | 4170 |
| 36 ½ | | 2500 | 2960 | 3413 | 3856 | 4285 | 4700 |
| 38 ½ | | 2798 | 3312 | 3820 | 4316 | 4797 | 5262 |
| 40 ½ | | 3111 | 3684 | 4249 | 4802 | 5337 | 5856 |
| 42 ½ | | 3441 | 4075 | 4702 | 5314 | 5907 | 6481 |
| 44 ½ | | 3788 | 4487 | 5177 | 5852 | 6505 | 7139 |
| 46 ½ | | 4152 | 4918 | 5776 | 6416 | 7133 | 7828 |
| 48 ½ | | 4533 | 5369 | 6197 | 7006 | 7790 | 8549 |
| 50 ½ | | 4930 | 5840 | 6742 | 7622 | 8475 | 9302 |
| 52 ½ | | 5344 | 6331 | 7309 | 8264 | 9189 | 10087 |
| 54 ½ | | 5775 | 6842 | 7899 | 8931 | 9933 | 10904 |
| 56 ½ | | 6222 | 7372 | 8513 | 9625 | 10705 | 11752 |
| 58 ½ | | 6686 | 7923 | 9149 | 10345 | 11507 | 12633 |
| 60 ½ | | 7167 | 8494 | 9808 | 11091 | 12338 | 13546 |
| t" | | I Axis Y - Y | | | | | |
| 0" | | 18.0 | 21.8 | 25.4 | 29.2 | 32.8 | 36.5 |
| ¼ | | 20.2 | 24.3 | 28.6 | 32.8 | 37.0 | 41.2 |
| 5/16 | | 20.8 | 25.0 | 29.5 | 33.7 | 38.1 | 42.5 |
| 3/8 | | 21.4 | 25.7 | 30.3 | 34.7 | 39.2 | 43.7 |
| 7/16 | | 22.0 | 26.5 | 31.2 | 35.8 | 40.4 | 45.0 |
| ½ | | 22.7 | 27.2 | 32.1 | 36.8 | 41.6 | 46.3 |
| 9/16 | | 23.3 | 28.0 | 33.1 | 37.9 | 42.8 | 47.7 |
| 5/8 | | 24.0 | 28.8 | 34.0 | 39.0 | 44.1 | 49.1 |
| ¾ | | 25.4 | 30.5 | 36.0 | 41.3 | 46.7 | 52.0 |




# MOMENTS OF INERTIA OF FOUR ANGLES

## EQUAL LEG ANGLES

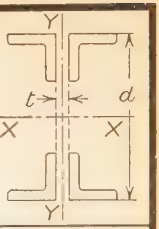
AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 4″ × 4″ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 |
| 4 | Area | 9.60 | 11.44 | 13.24 | 15.00 | 16.72 | 18.44 | 20.12 | 21.76 |
| L's | Weight | 32.8 | 39.2 | 45.2 | 51.2 | 57.2 | 62.8 | 68.4 | 74.0 |
| d″ | | I Axis X - X | | | | | | | |
| 8 1/2 | | 109 | 128 | 146 | 164 | 179 | 195 | 210 | 224 |
| 9 1/2 | | 141 | 166 | 191 | 213 | 234 | 255 | 275 | 294 |
| 10 1/2 | | 179 | 211 | 241 | 271 | 297 | 325 | 351 | 375 |
| 12 1/2 | | 267 | 316 | 363 | 408 | 449 | 491 | 532 | 570 |
| 14 1/2 | | 376 | 444 | 511 | 575 | 634 | 695 | 753 | 809 |
| 16 1/2 | | 503 | 596 | 685 | 772 | 853 | 935 | 1015 | 1091 |
| 18 1/2 | | 649 | 770 | 886 | 999 | 1105 | 1213 | 1316 | 1416 |
| 20 1/2 | | 815 | 967 | 1114 | 1256 | 1391 | 1527 | 1658 | 1785 |
| 22 1/2 | | 1000 | 1187 | 1369 | 1543 | 1710 | 1879 | 2041 | 2198 |
| 24 1/2 | | 1204 | 1430 | 1648 | 1860 | 2062 | 2267 | 2463 | 2656 |
| 26 1/2 | | 1427 | 1695 | 1955 | 2208 | 2448 | 2692 | 2926 | 3155 |
| 28 1/2 | | 1670 | 1984 | 2289 | 2585 | 2868 | 3154 | 3429 | 3697 |
| 30 1/2 | | 1932 | 2295 | 2648 | 2992 | 3320 | 3652 | 3972 | 4283 |
| 32 1/2 | | 2212 | 2629 | 3035 | 3429 | 3807 | 4188 | 4556 | 4914 |
| 34 1/2 | | 2513 | 2986 | 3448 | 3896 | 4326 | 4760 | 5179 | 5587 |
| 36 1/2 | | 2832 | 3367 | 3887 | 4393 | 4879 | 5369 | 5843 | 6304 |
| 38 1/2 | | 3170 | 3769 | 4353 | 4920 | 5466 | 6016 | 6548 | 7065 |
| 40 1/2 | | 3528 | 4195 | 4845 | 5477 | 6086 | 6699 | 7292 | 7869 |
| 42 1/2 | | 3905 | 4644 | 5364 | 6064 | 6739 | 7478 | 8077 | 8717 |
| 44 1/2 | | 4301 | 5115 | 5909 | 6681 | 7426 | 8175 | 8902 | 9609 |
| 46 1/2 | | 4716 | 5610 | 6481 | 7329 | 8146 | 8969 | 9767 | 10543 |
| 48 1/2 | | 5150 | 6127 | 7079 | 8006 | 8900 | 9799 | 10672 | 11522 |
| 50 1/2 | | 5605 | 6667 | 7703 | 8713 | 9687 | 10667 | 11618 | 12544 |
| 52 1/2 | | 6077 | 7231 | 8355 | 9450 | 10508 | 11571 | 12604 | 13609 |
| 54 1/2 | | 6569 | 7816 | 9032 | 10217 | 11362 | 12512 | 13630 | 14718 |
| 56 1/2 | | 7081 | 8425 | 9736 | 11014 | 12250 | 13490 | 14696 | 15870 |
| 58 1/2 | | 7611 | 9057 | 10467 | 11841 | 13170 | 14505 | 15803 | 17066 |
| 60 1/2 | | 8161 | 9712 | 11224 | 12698 | 14125 | 15557 | 16950 | 18306 |
| 62 1/2 | | 8730 | 10389 | 12007 | 13585 | 15113 | 16646 | 18137 | 19589 |
| 64 1/2 | | 9318 | 11089 | 12817 | 14502 | 16134 | 17771 | 19364 | 20915 |
| t″ | | I Axis Y - Y | | | | | | | |
| 0″ | | 26.9 | 32.3 | 37.7 | 43.1 | 49.0 | 54.5 | 60.1 | 65.7 |
| 1/4 | | 29.7 | 35.8 | 41.7 | 47.8 | 54.3 | 60.5 | 66.7 | 73.0 |
| 5/16 | | 30.5 | 36.7 | 42.8 | 49.0 | 55.7 | 62.1 | 68.5 | 74.9 |
| 3/8 | | 31.3 | 37.6 | 43.9 | 50.3 | 57.1 | 63.7 | 70.2 | 76.9 |
| 7/16 | | 32.1 | 38.6 | 45.1 | 51.6 | 58.6 | 65.3 | 72.1 | 78.9 |
| 1/2 | | 32.9 | 39.5 | 46.2 | 52.9 | 60.1 | 67.0 | 74.0 | 80.9 |
| 9/16 | | 33.7 | 40.5 | 47.4 | 54.3 | 61.6 | 68.7 | 75.9 | 83.0 |
| 5/8 | | 34.5 | 41.6 | 48.6 | 55.7 | 63.2 | 70.5 | 77.8 | 85.1 |
| 3/4 | | 36.3 | 43.7 | 51.1 | 58.5 | 66.5 | 74.1 | 81.8 | 89.5 |

# MOMENTS OF INERTIA OF FOUR ANGLES

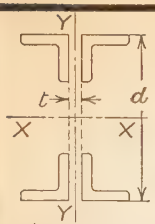
## EQUAL LEG ANGLES




AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 6″ × 6″ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ |
| 4 L's | Area | 17.44 | 20.24 | 23.00 | 25.72 | 28.44 | 31.12 | 33.76 | 36.36 | 38.92 | 41.48 | 44.00 |
| | Weight | 59.6 | 68.8 | 78.4 | 87.6 | 96.8 | 106.0 | 114.8 | 124.0 | 132.4 | 141.2 | 149.6 |
| d″ | | I Axis X - X | | | | | | | | | | |
| 12 1/2 | | 432 | 497 | 560 | 618 | 678 | 735 | 787 | 840 | 891 | 942 | 990 |
| 14 1/2 | | 610 | 703 | 793 | 878 | 963 | 1046 | 1123 | 1200 | 1275 | 1349 | 1421 |
| 16 1/2 | | 824 | 950 | 1072 | 1188 | 1306 | 1420 | 1526 | 1633 | 1737 | 1839 | 1938 |
| 18 1/2 | | 1072 | 1237 | 1398 | 1551 | 1705 | 1855 | 1996 | 2138 | 2276 | 2412 | 2545 |
| 20 1/2 | | 1351 | 1564 | 1769 | 1964 | 2161 | 2353 | 2535 | 2716 | 2894 | 3069 | 3239 |
| 22 1/2 | | 1672 | 1932 | 2186 | 2429 | 2674 | 2913 | 3140 | 3367 | 3589 | 3808 | 4021 |
| 24 1/2 | | 2025 | 2341 | 2649 | 2946 | 3244 | 3536 | 3813 | 4091 | 4362 | 4630 | 4892 |
| 26 1/2 | | 2412 | 2790 | 3159 | 3513 | 3871 | 4220 | 4554 | 4887 | 5212 | 5535 | 5850 |
| 28 1/2 | | 2835 | 3279 | 3714 | 4133 | 4555 | 4967 | 5362 | 5756 | 6141 | 6523 | 6896 |
| 30 1/2 | | 3292 | 3809 | 4315 | 4804 | 5295 | 5776 | 6238 | 6698 | 7147 | 7594 | 8031 |
| 32 1/2 | | 3784 | 4379 | 4962 | 5526 | 6093 | 6648 | 7181 | 7712 | 8232 | 8748 | 9253 |
| 34 1/2 | | 4311 | 4990 | 5655 | 6299 | 6947 | 7581 | 8192 | 8799 | 9394 | 9985 | 10563 |
| 36 1/2 | | 4873 | 5641 | 6395 | 7125 | 7858 | 8577 | 9270 | 9959 | 10634 | 11305 | 11962 |
| 38 1/2 | | 5470 | 6333 | 7180 | 8001 | 8826 | 9635 | 10416 | 11192 | 11952 | 12708 | 13448 |
| 40 1/2 | | 6102 | 7065 | 8011 | 8929 | 9851 | 10756 | 11629 | 12497 | 13347 | 14194 | 15022 |
| 42 1/2 | | 6768 | 7838 | 8888 | 9909 | 10933 | 11938 | 12910 | 13875 | 14821 | 15762 | 16685 |
| 44 1/2 | | 7470 | 8651 | 9812 | 10939 | 12072 | 13183 | 14259 | 15326 | 16372 | 17414 | 18435 |
| 46 1/2 | | 8206 | 9505 | 10781 | 12022 | 13268 | 14490 | 15675 | 16850 | 18001 | 19149 | 20273 |
| 48 1/2 | | 8977 | 10399 | 11796 | 13155 | 14520 | 15859 | 17158 | 18446 | 19709 | 20966 | 22200 |
| 50 1/2 | | 9783 | 11334 | 12857 | 14341 | 15829 | 17291 | 18709 | 20115 | 21493 | 22867 | 24214 |
| 52 1/2 | | 10624 | 12309 | 13964 | 15577 | 17196 | 18785 | 20327 | 21856 | 23356 | 24850 | 26316 |
| 54 1/2 | | 11500 | 13325 | 15118 | 16865 | 18619 | 20341 | 22013 | 23671 | 25297 | 26917 | 28507 |
| 56 1/2 | | 12411 | 14381 | 16317 | 18205 | 20099 | 21959 | 23767 | 25558 | 27315 | 29066 | 30785 |
| 58 1/2 | | 13356 | 15478 | 17562 | 19596 | 21636 | 23639 | 25588 | 27518 | 29411 | 31299 | 33151 |
| 60 1/2 | | 14337 | 16615 | 18853 | 21038 | 23230 | 25382 | 27476 | 29550 | 31585 | 33614 | 35605 |
| 62 1/2 | | 15352 | 17792 | 20191 | 22532 | 24880 | 27187 | 29432 | 31655 | 33837 | 36013 | 38148 |
| 64 1/2 | | 16402 | 19010 | 21574 | 24077 | 26588 | 29054 | 31456 | 33833 | 36167 | 38494 | 40778 |
| 66 1/2 | | 17488 | 20269 | 23003 | 25673 | 28352 | 30984 | 33547 | 36084 | 38575 | 41058 | 43496 |
| 68 1/2 | | 18608 | 21568 | 24478 | 27322 | 31073 | 32975 | 35706 | 38407 | 41060 | 43706 | 46303 |
| 70 1/2 | | 19762 | 22907 | 25999 | 29022 | 32052 | 35029 | 37932 | 40803 | 43623 | 46436 | 49197 |
| 72 1/2 | | 20952 | 24287 | 27567 | 30773 | 33987 | 37145 | 40225 | 43272 | 46264 | 49249 | 52179 |
| 74 1/2 | | 22177 | 25708 | 29180 | 32575 | 35979 | 39324 | 42587 | 45814 | 48983 | 52145 | 55250 |
| 76 1/2 | | 23436 | 27169 | 30839 | 34429 | 38027 | 41564 | 45015 | 48428 | 51780 | 55124 | 58408 |
| 78 1/2 | | 24731 | 28670 | 32544 | 36334 | 40133 | 43867 | 47512 | 51115 | 54655 | 58186 | 61654 |
| 80 1/2 | | 26060 | 30212 | 34295 | 38291 | 42296 | 46232 | 50075 | 53875 | 57607 | 61331 | 64989 |
| 82 1/2 | | 27424 | 31794 | 36093 | 40299 | 44515 | 48660 | 52707 | 56707 | 60638 | 64559 | 68411 |
| 84 1/2 | | 28823 | 33417 | 37936 | 42359 | 46792 | 51149 | 55405 | 59612 | 63746 | 67870 | 71921 |
| 90 1/2 | | 33230 | 38528 | 43742 | 48847 | 53962 | 58992 | 63907 | 68764 | 73537 | 78301 | 82980 |
| 96 1/2 | | 37950 | 44004 | 49961 | 55797 | 61644 | 67394 | 73016 | 78571 | 84029 | 89478 | 94831 |
| 102 1/2 | | 42984 | 49844 | 56595 | 63211 | 69838 | 76357 | 82733 | 89031 | 95222 | 101401 | 107474 |
| 108 1/2 | | 48332 | 56049 | 63643 | 71088 | 78544 | 85879 | 93057 | 100147 | 107116 | 114072 | 120909 |
| 114 1/2 | | 53994 | 62617 | 71104 | 79427 | 87762 | 95962 | 103989 | 111916 | 119709 | 127490 | 135136 |
| t″ | | I Axis Y - Y | | | | | | | | | | |
| 0″ | | 108.5 | 126.5 | 144.6 | 163.5 | 181.8 | 200.1 | 219.6 | 238.0 | 256.6 | 275.3 | 294.0 |
| 3/8 | | 119.8 | 139.8 | 159.8 | 180.9 | 201.2 | 221.6 | 243.3 | 263.9 | 284.6 | 305.4 | 326.3 |
| 7/16 | | 121.8 | 142.2 | 162.5 | 184.0 | 204.6 | 225.4 | 247.5 | 268.4 | 289.5 | 310.7 | 332.0 |
| 1/2 | | 123.9 | 144.6 | 165.3 | 187.1 | 208.1 | 229.2 | 251.7 | 273.0 | 294.4 | 316.1 | 337.7 |
| 5/8 | | 128.1 | 149.5 | 171.0 | 193.5 | 215.3 | 237.1 | 260.4 | 282.5 | 304.8 | 327.1 | 349.5 |
| 3/4 | | 132.4 | 154.5 | 176.8 | 200.1 | 222.7 | 245.3 | 269.4 | 292.2 | 315.2 | 338.4 | 361.6 |
| 7/8 | | 136.8 | 159.8 | 182.8 | 206.9 | 230.3 | 253.7 | 278.6 | 302.3 | 326.1 | 350.0 | 374.1 |
| 1″ | | 141.4 | 165.2 | 188.9 | 213.9 | 238.1 | 262.3 | 288.1 | 312.6 | 337.2 | 362.0 | 386.9 |
| 1 1/8 | | 146.2 | 170.7 | 195.3 | 221.1 | 246.1 | 271.2 | 297.9 | 323.2 | 348.7 | 374.3 | 400.0 |
| 1 1/4 | | 151.0 | 176.5 | 201.8 | 228.5 | 254.4 | 280.3 | 307.9 | 334.1 | 360.3 | 387.0 | 413.5 |
| 1 1/2 | | 161.2 | 188.3 | 215.5 | 243.9 | 271.6 | 299.3 | 328.7 | 356.7 | 384.7 | 413.1 | 441.6 |



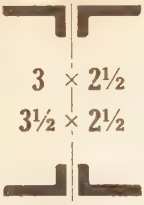

# MOMENTS OF INERTIA OF FOUR ANGLES

## EQUAL LEG ANGLES

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 8″ × 8″ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ | 1 1/16 | 1 1/8 |
| 4 | Area | 31 00 | 34 72 | 38 44 | 42 12 | 45 76 | 49 36 | 52 92 | 56 48 | 60 00 | 63 48 | 66 92 |
| L's | Weight | 105 6 | 118 4 | 130 8 | 143 2 | 155 6 | 168 0 | 180 0 | 192 4 | 204.0 | 216 0 | 227.6 |
| d″ | | I Axis X - X | | | | | | | | | | |
| 16 1/2 | | 1333 | 1483 | 1631 | 1775 | 1910 | 2046 | 2179 | 2310 | 2430 | 2554 | 2674 |
| 18 1/2 | | 1740 | 1937 | 2132 | 2322 | 2502 | 2683 | 2860 | 3034 | 3196 | 3361 | 3523 |
| 20 1/2 | | 2208 | 2461 | 2710 | 2954 | 3186 | 3419 | 3646 | 3871 | 4082 | 4296 | 4505 |
| 22 1/2 | | 2739 | 3054 | 3365 | 3670 | 3961 | 4253 | 4538 | 4821 | 5087 | 5357 | 5621 |
| 24 1/2 | | 3332 | 3716 | 4097 | 4471 | 4828 | 5186 | 5536 | 5884 | 6213 | 6646 | 6871 |
| 26 1/2 | | 3987 | 4448 | 4906 | 5355 | 5786 | 6217 | 6640 | 7060 | 7458 | 7861 | 8255 |
| 28 1/2 | | 4703 | 5249 | 5792 | 6324 | 6835 | 7348 | 7850 | 8349 | 8824 | 9303 | 9773 |
| 30 1/2 | | 5482 | 6120 | 6754 | 7377 | 7977 | 8577 | 9166 | 9751 | 10310 | 10872 | 11425 |
| 32 1/2 | | 6323 | 7060 | 7794 | 8514 | 9209 | 9904 | 10587 | 11266 | 11915 | 12569 | 13210 |
| 34 1/2 | | 7225 | 8070 | 8910 | 9736 | 10534 | 11331 | 12114 | 12893 | 13641 | 14392 | 15129 |
| 36 1/2 | | 8190 | 9149 | 10103 | 11041 | 11950 | 12856 | 13748 | 14634 | 15486 | 16342 | 17183 |
| 38 1/2 | | 9217 | 10298 | 11373 | 12431 | 13457 | 14480 | 15487 | 16488 | 17452 | 18419 | 19369 |
| 40 1/2 | | 10306 | 11516 | 12720 | 13905 | 15056 | 16203 | 17331 | 18454 | 19538 | 20623 | 21690 |
| 42 1/2 | | 11456 | 12803 | 14144 | 15464 | 16746 | 18024 | 19282 | 20534 | 21743 | 22954 | 24145 |
| 44 1/2 | | 12669 | 14160 | 15645 | 17107 | 18528 | 19944 | 21338 | 22726 | 24069 | 25412 | 26733 |
| 46 1/2 | | 13944 | 15586 | 17222 | 18833 | 20401 | 21963 | 23501 | 25032 | 26514 | 27997 | 29456 |
| 48 1/2 | | 15280 | 17082 | 18877 | 20645 | 22366 | 24081 | 25769 | 27450 | 29080 | 30709 | 32312 |
| 50 1/2 | | 16679 | 18647 | 20608 | 22540 | 24423 | 26291 | 28143 | 29982 | 31766 | 33548 | 35302 |
| 52 1/2 | | 18140 | 20282 | 22416 | 24520 | 26571 | 28612 | 30623 | 32626 | 34571 | 36513 | 38426 |
| 54 1/2 | | 19663 | 21986 | 24301 | 26584 | 28810 | 31026 | 33208 | 35384 | 37497 | 39606 | 41684 |
| 56 1/2 | | 21247 | 23759 | 26263 | 28732 | 31141 | 33538 | 35900 | 38254 | 40542 | 42826 | 45075 |
| 58 1/2 | | 22894 | 25602 | 28302 | 30964 | 33564 | 36149 | 38697 | 41237 | 43708 | 46172 | 48601 |
| 60 1/2 | | 24603 | 27515 | 30418 | 33281 | 36078 | 38859 | 41600 | 44333 | 46994 | 49646 | 52260 |
| 62 1/2 | | 26376 | 29497 | 32610 | 35681 | 38683 | 41668 | 44609 | 47543 | 50399 | 53247 | 56053 |
| 64 1/2 | | 28206 | 31548 | 34880 | 38167 | 41381 | 44575 | 47724 | 50865 | 53925 | 56974 | 59980 |
| 66 1/2 | | 30101 | 33669 | 37226 | 40736 | 44169 | 47581 | 50945 | 54300 | 57570 | 60829 | 64040 |
| 68 1/2 | | 32058 | 35859 | 39650 | 43389 | 47049 | 50686 | 54272 | 57848 | 61336 | 64810 | 68235 |
| 70 1/2 | | 34076 | 38118 | 42150 | 46127 | 50021 | 53889 | 57704 | 61509 | 65222 | 68919 | 72563 |
| 72 1/2 | | 36157 | 40447 | 44727 | 48949 | 53084 | 57191 | 61242 | 65283 | 69227 | 73154 | 77025 |
| 74 1/2 | | 38300 | 42846 | 47381 | 51856 | 56239 | 60592 | 64886 | 69170 | 73353 | 77516 | 81621 |
| 76 1/2 | | 40505 | 45314 | 50111 | 54846 | 59485 | 64092 | 68636 | 73170 | 77598 | 82006 | 86351 |
| 78 1/2 | | 42771 | 47851 | 52919 | 57921 | 62823 | 67690 | 72492 | 77283 | 81964 | 86622 | 91215 |
| 80 1/2 | | 45100 | 50458 | 55804 | 61080 | 66252 | 71387 | 76453 | 81509 | 86450 | 91365 | 96213 |
| 82 1/2 | | 47491 | 53134 | 58765 | 64323 | 69773 | 75183 | 80521 | 85847 | 91055 | 96235 | 101344 |
| 84 1/2 | | 49943 | 55880 | 61803 | 67651 | 73385 | 79077 | 84694 | 90299 | 95781 | 101233 | 106609 |
| 90 1/2 | | 57674 | 64533 | 71380 | 78139 | 84771 | 91353 | 97849 | 104332 | 110678 | 116986 | 123208 |
| 96 1/2 | | 65962 | 73812 | 81648 | 89385 | 96981 | 104518 | 111956 | 119382 | 126654 | 133882 | 141011 |
| 102 1/2 | | 74808 | 83715 | 92608 | 101389 | 110014 | 118570 | 127016 | 135448 | 143711 | 151920 | 160019 |
| 108 1/2 | | 84212 | 94244 | 104260 | 114151 | 123871 | 133512 | 143029 | 152531 | 161848 | 171101 | 180232 |
| 114 1/2 | | 94174 | 105397 | 116603 | 127672 | 138552 | 149341 | 159994 | 170630 | 181065 | 191425 | 201649 |
| 120 1/2 | | 104694 | 117176 | 129639 | 141950 | 154056 | 166060 | 177912 | 189747 | 201362 | 212891 | 224270 |
| t″ | | I Axis Y - Y | | | | | | | | | | |
| 0″ | | 343.2 | 385 9 | 428.8 | 471.8 | 516 8 | 560 1 | 603.2 | 646.6 | 692.9 | 736.7 | 780 8 |
| 3/8 | | 369.8 | 415 9 | 462.4 | 508.8 | 557.6 | 604 1 | 651.1 | 699.4 | 748.4 | 795.5 | 843.4 |
| 7/16 | | 374.4 | 421.2 | 468.2 | 515.3 | 564.7 | 611 8 | 659.4 | 708.4 | 758.0 | 805.8 | 854.3 |
| 1/2 | | 379.1 | 426 5 | 474.1 | 521.8 | 571.9 | 619 7 | 667.9 | 717.5 | 767.8 | 816.2 | 865.4 |
| 5/8 | | 388.7 | 437 3 | 486.2 | 535.1 | 586.5 | 635 6 | 685.1 | 736.1 | 787.7 | 837.4 | 887.9 |
| 3/4 | | 398.5 | 448.4 | 498.5 | 548.8 | 601.6 | 651 9 | 702.7 | 755.0 | 808.0 | 859.1 | 910.9 |
| 7/8 | | 408.5 | 459.7 | 511.2 | 562.7 | 616.9 | 668 6 | 720.8 | 774.5 | 828.8 | 881.3 | 934.5 |
| 1 ″ | | 418.9 | 471.3 | 524.2 | 577.0 | 632.6 | 685 7 | 739.2 | 794.3 | 850.1 | 904.0 | 958.5 |
| 1 1/8 | | 429.4 | 483 2 | 537.4 | 591.7 | 648.7 | 703 3 | 758.1 | 813.2 | 871.8 | 927.5 | 983.1 |
| 1 1/4 | | 440.2 | 495 4 | 551.0 | 606.6 | 665.1 | 721 2 | 777.3 | 833.9 | 894.1 | 951.2 | 1008.3 |
| 1 1/2 | | 462.6 | 520.6 | 579.1 | 637.6 | 699.1 | 758 1 | 817.1 | 876.6 | 940.0 | 1000 0 | 1060.1 |



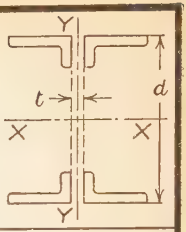
3 × 2½
3½ × 2½

# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

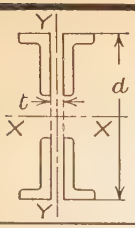
AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 3 × 2½ | | | |
|---|---|---|---|---|---|
| Thickness | | ¼ | 5/16 | ⅜ | 7/16 |
| 4 L's | Area | 5.24 | 6.48 | 7.68 | 8.88 |
| | Weight | 18.0 | 22.4 | 26.4 | 30.4 |
| d″ | | I Axis X - X | | | |
| 6 ½ | | 38 | 47 | 55 | 62 |
| 7 ½ | | 53 | 65 | 75 | 86 |
| 8 ½ | | 71 | 86 | 100 | 115 |
| 9 ½ | | 91 | 111 | 129 | 148 |
| 10 ½ | | 113 | 139 | 162 | 186 |
| 12 ½ | | 167 | 205 | 240 | 275 |
| 14 ½ | | 231 | 283 | 333 | 382 |
| 16 ½ | | 305 | 375 | 441 | 507 |
| 18 ½ | | 390 | 480 | 564 | 649 |
| 20 ½ | | 485 | 597 | 703 | 810 |
| 22 ½ | | 591 | 728 | 857 | 987 |
| 24 ½ | | 707 | 871 | 1027 | 1183 |
| t″ | | I Axis Y - Y | | | |
| 0″ | | 9.0 | 11.2 | 13.8 | 16.0 |
| ¼ | | 10.3 | 12.9 | 15.7 | 18.4 |
| 5/16 | | 10.6 | 13.3 | 16.2 | 19.0 |
| ⅜ | | 11.0 | 13.8 | 16.8 | 19.6 |
| 7/16 | | 11.4 | 14.2 | 17.3 | 20.3 |
| ½ | | 11.7 | 14.7 | 17.9 | 21.0 |
| 9/16 | | 12.1 | 15.2 | 18.5 | 21.6 |
| ⅝ | | 12.5 | 15.7 | 19.1 | 22.4 |
| ¾ | | 13.3 | 16.7 | 20.3 | 23.8 |

| Size | | 3½ × 2½ | | | | |
|---|---|---|---|---|---|---|
| Thickness | | ¼ | 5/16 | ⅜ | 7/16 | ½ |
| 4 L's | Area | 5.76 | 7.12 | 8.44 | 9.72 | 11.00 |
| | Weight | 19.6 | 24.4 | 28.8 | 33.2 | 37.6 |
| d″ | | I Axis X - X | | | | |
| 6 ½ | | 44 | 53 | 62 | 70 | 79 |
| 7 ½ | | 60 | 73 | 85 | 97 | 108 |
| 8 ½ | | 79 | 97 | 113 | 129 | 144 |
| 9 ½ | | 102 | 124 | 146 | 166 | 186 |
| 10 ½ | | 127 | 155 | 182 | 208 | 233 |
| 12 ½ | | 186 | 228 | 268 | 306 | 344 |
| 14 ½ | | 257 | 315 | 371 | 424 | 477 |
| 16 ½ | | 339 | 416 | 491 | 562 | 632 |
| 18 ½ | | 433 | 532 | 627 | 719 | 810 |
| 20 ½ | | 538 | 661 | 781 | 895 | 1009 |
| 22 ½ | | 655 | 805 | 951 | 1091 | 1230 |
| 24 ½ | | 784 | 963 | 1138 | 1306 | 1473 |
| t″ | | I Axis Y - Y | | | | |
| 0″ | | 14.3 | 18.1 | 21.4 | 25.1 | 28.6 |
| ¼ | | 16.0 | 20.2 | 24.2 | 28.2 | 32.3 |
| 5/16 | | 16.4 | 20.7 | 24.9 | 29.0 | 33.2 |
| ⅜ | | 16.9 | 21.3 | 25.6 | 29.8 | 34.1 |
| 7/16 | | 17.4 | 21.9 | 26.3 | 30.7 | 35.1 |
| ½ | | 17.9 | 22.5 | 27.0 | 31.5 | 36.1 |
| 9/16 | | 18.3 | 23.1 | 27.8 | 32.4 | 37.1 |
| ⅝ | | 18.9 | 23.8 | 28.5 | 33.3 | 38.1 |
| ¾ | | 19.9 | 25.1 | 30.1 | 35.1 | 40.2 |

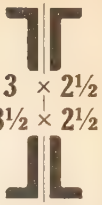



# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 3 × 2½ | | | |
|---|---|---|---|---|---|
| Thickness | | ¼ | 5/16 | ⅜ | 7/16 |
| 4 L's | Area | 5.24 | 6.48 | 7.68 | 8.88 |
| | Weight | 18.0 | 22.4 | 26.4 | 30.4 |
| d″ | | I Axis X - X | | | |
| 6 ½ | | 33 | 41 | 47 | 53 |
| 7 ½ | | 47 | 57 | 66 | 76 |
| 8 ½ | | 63 | 77 | 90 | 102 |
| 9 ½ | | 82 | 100 | 117 | 134 |
| 10 ½ | | 104 | 127 | 148 | 169 |
| 12 ½ | | 154 | 189 | 222 | 254 |
| 14 ½ | | 215 | 266 | 310 | 357 |
| 16 ½ | | 287 | 353 | 415 | 477 |
| 18 ½ | | 369 | 454 | 534 | 615 |
| 20 ½ | | 462 | 569 | 669 | 771 |
| 22 ½ | | 565 | 696 | 820 | 944 |
| 24 ½ | | 679 | 836 | 986 | 1135 |
| t″ | | I Axis Y - Y | | | |
| 0″ | | 5.2 | 6.6 | 8.0 | 9.5 |
| ¼ | | 6.2 | 7.8 | 9.5 | 11.2 |
| 5/16 | | 6.5 | 8.1 | 9.9 | 11.7 |
| ⅜ | | 6.7 | 8.5 | 10.3 | 12.2 |
| 7/16 | | 7.0 | 8.8 | 10.8 | 12.7 |
| ½ | | 7.3 | 9.2 | 11.2 | 13.2 |
| 9/16 | | 7.6 | 9.6 | 11.7 | 13.8 |
| ⅝ | | 7.9 | 10.0 | 12.2 | 14.4 |
| ¾ | | 8.6 | 10.8 | 13.2 | 15.6 |

| Size | | 3½ × 2½ | | | | |
|---|---|---|---|---|---|---|
| Thickness | | ¼ | 5/16 | ⅜ | 7/16 | ½ |
| 4 L's | Area | 5.76 | 7.12 | 8.44 | 9.72 | 11.00 |
| | Weight | 19.6 | 24.4 | 28.8 | 33.2 | 37.6 |
| d″ | | I Axis X - X | | | | |
| 7 ½ | | 47 | 57 | 67 | 76 | 84 |
| 8 ½ | | 64 | 78 | 91 | 103 | 115 |
| 9 ½ | | 84 | 101 | 119 | 136 | 152 |
| 10 ½ | | 106 | 129 | 151 | 173 | 193 |
| 12 ½ | | 159 | 195 | 229 | 261 | 293 |
| 14 ½ | | 224 | 275 | 323 | 370 | 415 |
| 16 ½ | | 301 | 369 | 434 | 497 | 560 |
| 18 ½ | | 389 | 477 | 563 | 645 | 726 |
| 20 ½ | | 488 | 600 | 708 | 811 | 914 |
| 22 ½ | | 599 | 737 | 870 | 997 | 1124 |
| 24 ½ | | 722 | 888 | 1048 | 1203 | 1356 |
| t″ | | I Axis Y - Y | | | | |
| 0″ | | 5.2 | 6.6 | 8.0 | 9.4 | 10.8 |
| ¼ | | 6.2 | 7.9 | 9.6 | 11.2 | 12.9 |
| 5/16 | | 6.5 | 8.3 | 10.0 | 11.7 | 13.5 |
| ⅜ | | 6.8 | 8.6 | 10.4 | 12.2 | 14.1 |
| 7/16 | | 7.1 | 9.0 | 10.9 | 12.8 | 14.7 |
| ½ | | 7.4 | 9.4 | 11.3 | 13.3 | 15.4 |
| 9/16 | | 7.7 | 9.8 | 11.8 | 13.9 | 16.0 |
| ⅝ | | 8.0 | 10.2 | 12.3 | 14.5 | 16.7 |
| ¾ | | 8.7 | 11.0 | 13.4 | 15.7 | 18.2 |

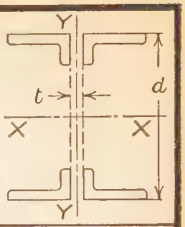
# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

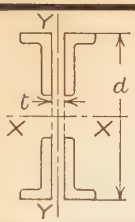
AXIS X - X for distances measured from back to back.

AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 4″ × 3″ | | | | | |
|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 |
| 4 | Area | 8.36 | 9.92 | 11.48 | 13.00 | 14.48 | 15.92 |
| L's | Weight | 28.8 | 34.0 | 39.2 | 44.4 | 49.6 | 54.4 |
| d″ | | I Axis X - X | | | | | |
| 6 1/2 | | 58 | 68 | 78 | 86 | 94 | 102 |
| 7 1/2 | | 81 | 95 | 109 | 121 | 132 | 144 |
| 8 1/2 | | 108 | 127 | 145 | 162 | 178 | 193 |
| 9 1/2 | | 140 | 164 | 188 | 209 | 231 | 251 |
| 10 1/2 | | 175 | 206 | 236 | 264 | 291 | 317 |
| 12 1/2 | | 259 | 305 | 350 | 392 | 433 | 472 |
| 14 1/2 | | 359 | 423 | 486 | 546 | 604 | 659 |
| 16 1/2 | | 476 | 561 | 646 | 725 | 804 | 879 |
| 18 1/2 | | 609 | 719 | 828 | 931 | 1032 | 1129 |
| 20 1/2 | | 760 | 897 | 1034 | 1163 | 1290 | 1412 |
| 22 1/2 | | 927 | 1095 | 1262 | 1421 | 1577 | 1727 |
| 24 1/2 | | 1110 | 1313 | 1514 | 1705 | 1892 | 2073 |
| 26 1/2 | | 1311 | 1550 | 1788 | 2015 | 2237 | 2451 |
| 28 1/2 | | 1528 | 1808 | 2085 | 2351 | 2611 | 2862 |
| 30 1/2 | | 1762 | 2085 | 2406 | 2713 | 3013 | 3303 |
| 32 1/2 | | 2012 | 2382 | 2749 | 3101 | 3445 | 3777 |
| 34 1/2 | | 2280 | 2699 | 3115 | 3515 | 3905 | 4283 |
| 36 1/2 | | 2564 | 3035 | 3504 | 3955 | 4395 | 4820 |
| 38 1/2 | | 2865 | 3392 | 3917 | 4421 | 4913 | 5390 |
| 40 1/2 | | 3182 | 3768 | 4352 | 4912 | 5460 | 5991 |
| 42 1/2 | | 3516 | 4164 | 4810 | 5430 | 6037 | 6624 |
| 44 1/2 | | 3867 | 4580 | 5291 | 5974 | 6642 | 7289 |
| 46 1/2 | | 4235 | 5016 | 5795 | 6544 | 7276 | 7986 |
| 48 1/2 | | 4619 | 5472 | 6322 | 7140 | 7939 | 8714 |
| 50 1/2 | | 5021 | 5948 | 6871 | 7762 | 8631 | 9475 |
| 52 1/2 | | 5438 | 6443 | 7444 | 8410 | 9353 | 10266 |
| 54 1/2 | | 5873 | 6958 | 8040 | 9084 | 10103 | 11090 |
| 56 1/2 | | 6324 | 7493 | 8659 | 9784 | 10882 | 11946 |
| 58 1/2 | | 6792 | 8048 | 9301 | 10510 | 11690 | 12834 |
| t″ | | I Axis Y - Y | | | | | |
| 0″ | | 26.8 | 32.1 | 37.5 | 43.2 | 48.6 | 54.0 |
| 1/4 | | 29.6 | 35.4 | 41.4 | 47.7 | 53.7 | 59.7 |
| 5/16 | | 30.3 | 36.3 | 42.4 | 48.9 | 55.1 | 61.2 |
| 3/8 | | 31.0 | 37.2 | 43.5 | 50.1 | 56.4 | 62.7 |
| 7/16 | | 31.8 | 38.2 | 44.6 | 51.4 | 57.8 | 64.3 |
| 1/2 | | 32.6 | 39.1 | 45.7 | 52.7 | 59.3 | 65.9 |
| 9/16 | | 33.4 | 40.1 | 46.8 | 53.9 | 60.7 | 67.5 |
| 5/8 | | 34.2 | 41.0 | 47.9 | 55.3 | 62.2 | 69.2 |
| 3/4 | | 35.9 | 43.0 | 50.3 | 58.0 | 65.3 | 72.6 |




# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 4″ × 3″ | | | | | |
|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 |
| 4 L's | Area | 8.36 | 9.92 | 11.48 | 13.00 | 14.48 | 15.92 |
| | Weight | 28.8 | 34.0 | 39.2 | 44.4 | 49.6 | 54.4 |
| d″ | | I Axis X - X | | | | | |
| 8 1/2 | | 88 | 103 | 118 | 131 | 144 | 156 |
| 9 1/2 | | 115 | 135 | 155 | 172 | 190 | 206 |
| 10 1/2 | | 147 | 172 | 197 | 220 | 242 | 264 |
| 12 1/2 | | 222 | 261 | 299 | 335 | 370 | 403 |
| 14 1/2 | | 313 | 369 | 424 | 476 | 526 | 575 |
| 16 1/2 | | 422 | 498 | 573 | 643 | 712 | 778 |
| 18 1/2 | | 547 | 646 | 744 | 836 | 926 | 1013 |
| 20 1/2 | | 689 | 814 | 938 | 1055 | 1169 | 1279 |
| 22 1/2 | | 848 | 1002 | 1155 | 1299 | 1441 | 1578 |
| 24 1/2 | | 1023 | 1210 | 1395 | 1570 | 1743 | 1909 |
| 26 1/2 | | 1215 | 1437 | 1657 | 1867 | 2073 | 2271 |
| 28 1/2 | | 1424 | 1685 | 1943 | 2190 | 2432 | 2665 |
| 30 1/2 | | 1650 | 1952 | 2252 | 2539 | 2820 | 3091 |
| 32 1/2 | | 1892 | 2239 | 2584 | 2914 | 3237 | 3549 |
| 34 1/2 | | 2151 | 2546 | 2939 | 3315 | 3683 | 4039 |
| 36 1/2 | | 2427 | 2873 | 3316 | 3742 | 4158 | 4560 |
| 38 1/2 | | 2719 | 3219 | 3717 | 4195 | 4662 | 5114 |
| 40 1/2 | | 3028 | 3586 | 4141 | 4674 | 5195 | 5699 |
| 42 1/2 | | 3354 | 3972 | 4587 | 5179 | 5756 | 6316 |
| 44 1/2 | | 3697 | 4378 | 5057 | 5710 | 6347 | 6965 |
| 46 1/2 | | 4056 | 4804 | 5549 | 6267 | 6967 | 7646 |
| 48 1/2 | | 4432 | 5250 | 6065 | 6849 | 7616 | 8358 |
| 50 1/2 | | 4825 | 5715 | 6603 | 7458 | 8293 | 9103 |
| 52 1/2 | | 5234 | 6201 | 7164 | 8093 | 9000 | 9879 |
| 54 1/2 | | 5661 | 6706 | 7749 | 8754 | 9736 | 10687 |
| 56 1/2 | | 6103 | 7231 | 8356 | 9441 | 10500 | 11527 |
| 58 1/2 | | 6563 | 7776 | 8986 | 10154 | 11294 | 12399 |
| 60 1/2 | | 7039 | 8341 | 9639 | 10893 | 12116 | 13302 |
| 62 1/2 | | 7533 | 8926 | 10316 | 11658 | 12967 | 14238 |
| t″ | | I Axis Y - Y | | | | | |
| 0″ | | 11.4 | 13.7 | 16.1 | 18.6 | 21.1 | 23.5 |
| 1/4 | | 13.1 | 15.8 | 18.5 | 21.5 | 24.4 | 27.2 |
| 5/16 | | 13.6 | 16.4 | 19.2 | 22.3 | 25.3 | 28.2 |
| 3/8 | | 14.1 | 17.0 | 19.9 | 23.1 | 26.2 | 29.3 |
| 7/16 | | 14.6 | 17.6 | 20.6 | 24.0 | 27.2 | 30.4 |
| 1/2 | | 15.1 | 18.2 | 21.4 | 24.8 | 28.2 | 31.5 |
| 9/16 | | 15.7 | 18.9 | 22.1 | 25.7 | 29.2 | 32.6 |
| 5/8 | | 16.2 | 19.5 | 22.9 | 26.7 | 30.2 | 33.7 |
| 3/4 | | 17.4 | 20.9 | 24.6 | 28.6 | 32.4 | 36.2 |

# MOMENTS OF INERTIA OF FOUR ANGLES

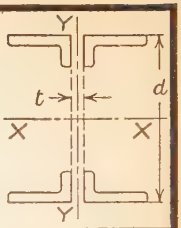
## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

**4 × 3½**

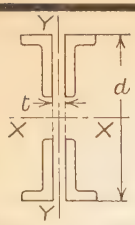
AXIS X - X for distances measured back to back.

AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 4" × 3 ½" | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | ½ | 9/16 | 5/8 | 11/16 | ¾ |
| 4 | Area | 9.00 | 10.68 | 12.36 | 14.00 | 15.60 | 17.20 | 18.72 | 20.24 |
| L's | Weight | 30 8 | 36 4 | 42 4 | 47.6 | 53 2 | 58 8 | 64 0 | 69.2 |
| d" | | I Axis X - X | | | | | | | |
| 7 ½ | | 82 | 95 | 108 | 121 | 133 | 144 | 154 | 164 |
| 8 ½ | | 109 | 128 | 146 | 163 | 179 | 195 | 209 | 223 |
| 9 ½ | | 142 | 165 | 189 | 212 | 234 | 255 | 273 | 292 |
| 10 ½ | | 178 | 209 | 239 | 268 | 296 | 323 | 347 | 371 |
| 12 ½ | | 265 | 311 | 357 | 401 | 443 | 485 | 522 | 560 |
| 14 ½ | | 370 | 435 | 500 | 562 | 622 | 681 | 734 | 789 |
| 16 ½ | | 492 | 580 | 667 | 751 | 832 | 912 | 985 | 1058 |
| 18 ½ | | 633 | 746 | 859 | 968 | 1073 | 1177 | 1272 | 1368 |
| 20 ½ | | 792 | 934 | 1076 | 1213 | 1346 | 1477 | 1597 | 1719 |
| 22 ½ | | 969 | 1143 | 1317 | 1486 | 1649 | 1811 | 1959 | 2110 |
| 24 ½ | | 1163 | 1373 | 1583 | 1787 | 1984 | 2179 | 2359 | 2542 |
| 26 ½ | | 1376 | 1625 | 1874 | 2116 | 2350 | 2582 | 2797 | 3014 |
| 28 ½ | | 1607 | 1898 | 2190 | 2473 | 2747 | 3019 | 3271 | 3526 |
| 30 ½ | | 1856 | 2193 | 2531 | 2858 | 3176 | 3491 | 3784 | 4079 |
| 32 ½ | | 2123 | 2509 | 2896 | 3271 | 3635 | 3997 | 4333 | 4672 |
| 34 ½ | | 2407 | 2846 | 3285 | 3712 | 4126 | 4538 | 4920 | 5306 |
| 36 ½ | | 2710 | 3205 | 3700 | 4181 | 4648 | 5112 | 5545 | 5981 |
| 38 ½ | | 3031 | 3585 | 4139 | 4678 | 5201 | 5722 | 6207 | 6696 |
| 40 ½ | | 3370 | 3986 | 4603 | 5203 | 5785 | 6365 | 6906 | 7451 |
| 42 ½ | | 3726 | 4409 | 5092 | 5756 | 6401 | 7043 | 7643 | 8247 |
| 44 ½ | | 4101 | 4853 | 5605 | 6337 | 7048 | 7756 | 8417 | 9083 |
| 46 ½ | | 4494 | 5318 | 6144 | 6946 | 7726 | 8502 | 9229 | 9960 |
| 48 ½ | | 4905 | 5805 | 6706 | 7583 | 8435 | 9284 | 10078 | 10877 |
| 50 ½ | | 5333 | 6313 | 7294 | 8248 | 9175 | 10099 | 10965 | 11835 |
| 52 ½ | | 5780 | 6843 | 7906 | 8941 | 9947 | 10949 | 11889 | 12833 |
| 54 ½ | | 6245 | 7394 | 8543 | 9662 | 10750 | 11834 | 12850 | 13872 |
| 56 ½ | | 6728 | 7966 | 9205 | 10411 | 11584 | 12753 | 13849 | 14951 |
| 58 ½ | | 7228 | 8559 | 9892 | 11188 | 12449 | 13706 | 14885 | 16073 |
| 60 ½ | | 7747 | 9174 | 10603 | 11993 | 13345 | 14693 | 15959 | 17231 |
| t" | | I Axis Y - Y | | | | | | | |
| 0 | | 26 8 | 32 4 | 37 7 | 43 2 | 48 6 | 54 1 | 60 1 | 65 6 |
| ¼ | | 29 6 | 35 8 | 41 7 | 47 7 | 53 8 | 59 9 | 66 5 | 72 7 |
| 5/16 | | 30 3 | 36 6 | 42 8 | 49 0 | 55 2 | 61 4 | 68 2 | 74 6 |
| 3/8 | | 31 1 | 37 6 | 43 9 | 50 2 | 56 6 | 63 0 | 70 0 | 76 5 |
| 7/16 | | 31 8 | 38 5 | 45 0 | 51 5 | 58 0 | 64 6 | 71 7 | 78 4 |
| ½ | | 32 6 | 39 5 | 46 1 | 52 8 | 59 5 | 66 3 | 73 6 | 80 4 |
| 9/16 | | 33 5 | 40 5 | 47 3 | 54 1 | 61 0 | 67 9 | 75 4 | 82 5 |
| 5/8 | | 34 3 | 11 5 | 48 4 | 55 5 | 62 5 | 69 6 | 77 3 | 84 6 |
| ¾ | | 36 0 | 43 6 | 50 9 | 58 2 | 65 7 | 73 2 | 81 2 | 88 8 |



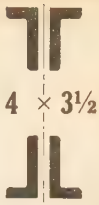

# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.

AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.



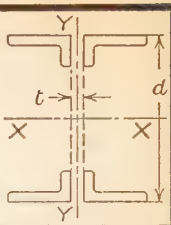

| Size | | 4″ × 3 ½″ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | ½ | 9/16 | 5/8 | 11/16 | ¾ |
| 4 L's | Area | 9.00 | 10.68 | 12.36 | 14.00 | 15.60 | 17.20 | 18.72 | 20.24 |
| | Weight | 30.8 | 36.4 | 42.4 | 47.6 | 53.2 | 58.8 | 64.0 | 69.2 |
| d″ | | I Axis X - X | | | | | | | |
| 8 ½ | | 99 | 115 | 132 | 147 | 162 | 176 | 188 | 201 |
| 9 ½ | | 129 | 151 | 172 | 193 | 212 | 231 | 248 | 265 |
| 10 ½ | | 163 | 191 | 219 | 245 | 271 | 295 | 317 | 339 |
| 12 ½ | | 246 | 288 | 331 | 371 | 410 | 449 | 482 | 517 |
| 14 ½ | | 346 | 406 | 467 | 525 | 581 | 636 | 686 | 736 |
| 16 ½ | | 464 | 546 | 628 | 707 | 783 | 859 | 926 | 996 |
| 18 ½ | | 600 | 707 | 814 | 917 | 1017 | 1115 | 1205 | 1296 |
| 20 ½ | | 755 | 890 | 1025 | 1155 | 1281 | 1406 | 1520 | 1636 |
| 22 ½ | | 927 | 1093 | 1260 | 1421 | 1577 | 1732 | 1873 | 2017 |
| 24 ½ | | 1117 | 1318 | 1520 | 1715 | 1904 | 2092 | 2264 | 2438 |
| 26 ½ | | 1325 | 1565 | 1805 | 2037 | 2262 | 2486 | 2692 | 2900 |
| 28 ½ | | 1552 | 1833 | 2114 | 2387 | 2652 | 2914 | 3157 | 3403 |
| 30 ½ | | 1796 | 2122 | 2449 | 2765 | 3072 | 3377 | 3660 | 3945 |
| 32 ½ | | 2058 | 2433 | 2807 | 3171 | 3524 | 3875 | 4200 | 4529 |
| 34 ½ | | 2338 | 2764 | 3191 | 3605 | 4007 | 4407 | 4778 | 5153 |
| 36 ½ | | 2637 | 3118 | 3599 | 4067 | 4521 | 4973 | 5393 | 5817 |
| 38 ½ | | 2953 | 3492 | 4033 | 4557 | 5067 | 5574 | 6046 | 6522 |
| 40 ½ | | 3287 | 3888 | 4490 | 5075 | 5643 | 6209 | 6736 | 7267 |
| 42 ½ | | 3639 | 4306 | 4973 | 5621 | 6251 | 6878 | 7463 | 8053 |
| 44 ½ | | 4010 | 4745 | 5480 | 6195 | 6890 | 7582 | 8228 | 8879 |
| 46 ½ | | 4398 | 5205 | 6012 | 6797 | 7560 | 8320 | 9030 | 9745 |
| 48 ½ | | 4804 | 5686 | 6569 | 7427 | 8261 | 9093 | 9870 | 10653 |
| 50 ½ | | 5229 | 6189 | 7150 | 8085 | 8994 | 9900 | 10747 | 11600 |
| 52 ½ | | 5671 | 6713 | 7756 | 8771 | 9758 | 10741 | 11662 | 12588 |
| 54 ½ | | 6131 | 7259 | 8387 | 9485 | 10553 | 11617 | 12614 | 13617 |
| 56 ½ | | 6609 | 7826 | 9043 | 10227 | 11379 | 12527 | 13604 | 14686 |
| 58 ½ | | 7106 | 8414 | 9723 | 10997 | 12236 | 13472 | 14631 | 15796 |
| 60 ½ | | 7620 | 9023 | 10428 | 11795 | 13125 | 14451 | 15695 | 16946 |
| t″ | | I Axis Y - Y | | | | | | | |
| 0″ | | 18.0 | 21.8 | 25.5 | 29.2 | 32.9 | 36.6 | 40.9 | 44.8 |
| ¼ | | 20.2 | 24.5 | 28.7 | 32.9 | 37.1 | 41.3 | 46.2 | 50.6 |
| 5/16 | | 20.8 | 25.3 | 29.6 | 33.9 | 38.3 | 42.6 | 47.6 | 52.2 |
| 3/8 | | 21.4 | 26.0 | 30.4 | 34.9 | 39.4 | 43.9 | 49.0 | 53.8 |
| 7/16 | | 22.1 | 26.8 | 31.4 | 36.0 | 40.6 | 45.2 | 50.5 | 55.4 |
| ½ | | 22.7 | 27.6 | 32.3 | 37.0 | 41.8 | 46.6 | 52.1 | 57.1 |
| 9/16 | | 23.4 | 28.4 | 33.3 | 38.1 | 43.1 | 48.0 | 53.6 | 58.8 |
| 5/8 | | 24.1 | 29.3 | 34.2 | 39.3 | 44.4 | 49.4 | 55.2 | 60.5 |
| ¾ | | 25.5 | 31.0 | 36.3 | 41.6 | 47.0 | 52.4 | 58.5 | 64.2 |

# MOMENTS OF INERTIA OF FOUR ANGLES

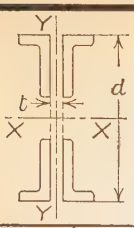
## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 5″ × 3″ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 |
| 4 | Area | 9.60 | 11.44 | 13.24 | 15.00 | 16.72 | 18.44 | 20.12 | 21.76 |
| L's | Weight | 32.8 | 39.2 | 45.2 | 51.2 | 57.2 | 62.8 | 68.4 | 74.0 |
| d″ | | I Axis X - X | | | | | | | |
| 6 1/2 | | 73 | 83 | 93 | 104 | 114 | 123 | 132 | 140 |
| 7 1/2 | | 97 | 115 | 130 | 145 | 160 | 173 | 186 | 198 |
| 8 1/2 | | 129 | 152 | 173 | 194 | 214 | 232 | 250 | 267 |
| 9 1/2 | | 166 | 196 | 223 | 250 | 276 | 300 | 334 | 347 |
| 10 1/2 | | 207 | 245 | 280 | 314 | 346 | 377 | 408 | 437 |
| 12 1/2 | | 305 | 361 | 413 | 464 | 513 | 560 | 606 | 651 |
| 14 1/2 | | 421 | 499 | 573 | 644 | 713 | 779 | 845 | 908 |
| 16 1/2 | | 557 | 660 | 759 | 854 | 947 | 1036 | 1124 | 1209 |
| 18 1/2 | | 712 | 845 | 970 | 1094 | 1214 | 1329 | 1443 | 1553 |
| 20 1/2 | | 886 | 1052 | 1209 | 1364 | 1514 | 1659 | 1802 | 1941 |
| 22 1/2 | | 1080 | 1282 | 1475 | 1664 | 1848 | 2026 | 2202 | 2372 |
| 24 1/2 | | 1292 | 1534 | 1766 | 1994 | 2215 | 2430 | 2642 | 2847 |
| 26 1/2 | | 1524 | 1810 | 2085 | 2354 | 2615 | 2871 | 3122 | 3365 |
| 28 1/2 | | 1775 | 2109 | 2429 | 2744 | 3049 | 3348 | 3642 | 3927 |
| 30 1/2 | | 2045 | 2430 | 2801 | 3164 | 3517 | 3863 | 4203 | 4532 |
| 32 1/2 | | 2334 | 2774 | 3198 | 3614 | 4018 | 4414 | 4803 | 5181 |
| 34 1/2 | | 2643 | 3142 | 3623 | 4094 | 4552 | 5002 | 5444 | 5874 |
| 36 1/2 | | 2971 | 3532 | 4073 | 4604 | 5120 | 5627 | 6126 | 6610 |
| 38 1/2 | | 3318 | 3945 | 4551 | 5144 | 5721 | 6289 | 6847 | 7389 |
| 40 1/2 | | 3684 | 4381 | 5054 | 5714 | 6356 | 6988 | 7609 | 8212 |
| 42 1/2 | | 4069 | 4839 | 5584 | 6314 | 7024 | 7724 | 8411 | 9079 |
| 44 1/2 | | 4474 | 5321 | 6141 | 6944 | 7726 | 8497 | 9253 | 9989 |
| 46 1/2 | | 4897 | 5825 | 6724 | 7604 | 8461 | 9306 | 10136 | 10942 |
| 48 1/2 | | 5340 | 6353 | 7334 | 8294 | 9229 | 10153 | 11058 | 11939 |
| 50 1/2 | | 5802 | 6903 | 7970 | 9014 | 10031 | 11036 | 12021 | 12980 |
| 52 1/2 | | 6284 | 7476 | 8632 | 9764 | 10866 | 11956 | 13024 | 14064 |
| 54 1/2 | | 6784 | 8072 | 9321 | 10544 | 11735 | 12913 | 14067 | 15191 |
| 56 1/2 | | 7304 | 8691 | 10037 | 11354 | 12637 | 13907 | 15152 | 16363 |
| 58 1/2 | | 7843 | 9333 | 10779 | 12194 | 13573 | 14938 | 16275 | 17577 |
| t″ | | I Axis Y - Y | | | | | | | |
| 0″ | | 52.1 | 62.5 | 73.3 | 83.7 | 94.1 | 105.2 | 115.8 | 126.3 |
| 1/4 | | 56.3 | 67.6 | 79.3 | 90.5 | 101.8 | 113.8 | 125.2 | 136.6 |
| 5/16 | | 57.4 | 68.9 | 80.8 | 92.3 | 103.8 | 116.1 | 127.7 | 139.3 |
| 3/8 | | 58.5 | 70.2 | 82.4 | 94.1 | 105.8 | 118.3 | 130.2 | 142.0 |
| 7/16 | | 59.7 | 71.6 | 84.0 | 96.0 | 107.8 | 120.6 | 132.7 | 144.8 |
| 1/2 | | 60.8 | 73.0 | 85.6 | 97.8 | 109.9 | 123.0 | 135.3 | 147.6 |
| 9/16 | | 62.0 | 74.4 | 87.3 | 99.7 | 112.1 | 125.4 | 138.0 | 150.5 |
| 5/8 | | 63.2 | 75.8 | 89.0 | 101.6 | 114.2 | 127.8 | 140.6 | 153.4 |
| 3/4 | | 65.6 | 78.7 | 92.4 | 105.5 | 118.6 | 132.7 | 146.1 | 159.4 |



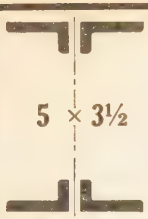

# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 5″ × 3″ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 |
| 4 L's | Area | 9.60 | 11.44 | 13.24 | 15.00 | 16.72 | 18.44 | 20.12 | 21.76 |
| | Weight | 32.8 | 39.2 | 45.2 | 51.2 | 57.2 | 62.8 | 68.4 | 74.0 |
| d″ | | I Axis X - X | | | | | | | |
| 10 1/2 | | 147 | 174 | 198 | 222 | 244 | 265 | 286 | 306 |
| 12 1/2 | | 226 | 266 | 304 | 342 | 377 | 411 | 444 | 476 |
| 14 1/2 | | 323 | 382 | 437 | 492 | 544 | 593 | 642 | 689 |
| 16 1/2 | | 439 | 520 | 597 | 672 | 744 | 813 | 881 | 947 |
| 18 1/2 | | 575 | 682 | 782 | 882 | 977 | 1069 | 1160 | 1247 |
| 20 1/2 | | 730 | 866 | 995 | 1122 | 1244 | 1362 | 1479 | 1592 |
| 22 1/2 | | 904 | 1073 | 1234 | 1392 | 1544 | 1692 | 1838 | 1979 |
| 24 1/2 | | 1098 | 1303 | 1499 | 1692 | 1878 | 2059 | 2238 | 2411 |
| 26 1/2 | | 1310 | 1556 | 1791 | 2022 | 2245 | 2463 | 2678 | 2885 |
| 28 1/2 | | 1542 | 1831 | 2109 | 2382 | 2646 | 2904 | 3158 | 3404 |
| 30 1/2 | | 1793 | 2130 | 2454 | 2772 | 3080 | 3381 | 3678 | 3966 |
| 32 1/2 | | 2063 | 2451 | 2825 | 3192 | 3547 | 3896 | 4239 | 4571 |
| 34 1/2 | | 2352 | 2796 | 3223 | 3642 | 4048 | 4447 | 4839 | 5220 |
| 36 1/2 | | 2661 | 3163 | 3647 | 4122 | 4583 | 5035 | 5480 | 5912 |
| 38 1/2 | | 2989 | 3553 | 4098 | 4632 | 5151 | 5660 | 6162 | 6648 |
| 40 1/2 | | 3336 | 3966 | 4575 | 5172 | 5752 | 6322 | 6883 | 7428 |
| 42 1/2 | | 3702 | 4402 | 5079 | 5742 | 6386 | 7021 | 7645 | 8251 |
| 44 1/2 | | 4087 | 4861 | 5609 | 6342 | 7055 | 7757 | 8447 | 9117 |
| 46 1/2 | | 4492 | 5342 | 6165 | 6972 | 7756 | 8530 | 9289 | 10027 |
| 48 1/2 | | 4915 | 5847 | 6748 | 7632 | 8491 | 9339 | 10172 | 10981 |
| 50 1/2 | | 5358 | 6374 | 7358 | 8322 | 9260 | 10186 | 11094 | 11978 |
| 52 1/2 | | 5820 | 6924 | 7994 | 9042 | 10062 | 11069 | 12057 | 13018 |
| 54 1/2 | | 6302 | 7497 | 8657 | 9792 | 10897 | 11989 | 13060 | 14102 |
| 56 1/2 | | 6802 | 8094 | 9346 | 10572 | 11766 | 12946 | 14104 | 15230 |
| 58 1/2 | | 7322 | 8712 | 10061 | 11382 | 12668 | 13940 | 15187 | 16401 |
| 60 1/2 | | 7861 | 9354 | 10803 | 12222 | 13603 | 14971 | 16311 | 17616 |
| 62 1/2 | | 8419 | 10019 | 11571 | 13092 | 14573 | 16038 | 17475 | 18874 |
| t″ | | I Axis Y - Y | | | | | | | |
| 0″ | | 11.4 | 1.38 | 16.3 | 18.8 | 21.2 | 24.0 | 26.7 | 29.4 |
| 1/4 | | 13.2 | 16.0 | 19.0 | 21.8 | 24.7 | 28.0 | 31.1 | 34.3 |
| 5/16 | | 13.7 | 16.6 | 19.7 | 22.6 | 25.7 | 29.1 | 32.3 | 35.6 |
| 3/8 | | 14.2 | 17.2 | 20.4 | 23.5 | 26.7 | 30.2 | 33.6 | 37.0 |
| 7/16 | | 14.8 | 17.8 | 21.2 | 24.4 | 27.7 | 31.4 | 34.9 | 38 4 |
| 1/2 | | 15.3 | 18.5 | 22.0 | 25.3 | 28.7 | 32.6 | 36.2 | 39.9 |
| 9/16 | | 15.9 | 19.2 | 22.8 | 26.3 | 29.8 | 33.8 | 37.6 | 41.4 |
| 5/8 | | 16.5 | 19.9 | 23.7 | 27.3 | 30.9 | 35.1 | 39.0 | 42.9 |
| 3/4 | | 17.7 | 21.4 | 25.4 | 29.3 | 33.2 | 37.7 | 41.9 | 46.2 |



# MOMENTS OF INERTIA OF FOUR ANGLES

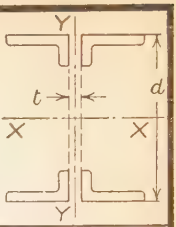
## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

**5 × 3½**

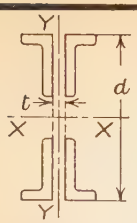
AXIS X - X for distances measured from back to back.

AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 5″ × 3½″ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 |
| 4 | Area | 10.24 | 12 20 | 14 12 | 16 00 | 17 88 | 19 68 | 21 48 | 23.24 |
| L's | Weight | 34.8 | 41.6 | 48.0 | 54.4 | 60 8 | 67.2 | 73 2 | 79 2 |
| d″ | | I Axis X - X | | | | | | | |
| 7 ½ | | 98 | 115 | 131 | 145 | 160 | 174 | 187 | 198 |
| 8 ½ | | 130 | 153 | 175 | 195 | 215 | 233 | 252 | 268 |
| 9 ½ | | 167 | 197 | 226 | 252 | 279 | 303 | 328 | 349 |
| 10 ½ | | 210 | 248 | 284 | 318 | 351 | 382 | 414 | 442 |
| 12 ½ | | 311 | 367 | 422 | 472 | 524 | 571 | 620 | 663 |
| 14 ½ | | 432 | 511 | 587 | 659 | 732 | 800 | 868 | 930 |
| 16 ½ | | 573 | 679 | 781 | 878 | 976 | 1067 | 1159 | 1244 |
| 18 ½ | | 735 | 872 | 1004 | 1129 | 1256 | 1374 | 1493 | 1604 |
| 20 ½ | | 918 | 1088 | 1254 | 1412 | 1571 | 1721 | 1871 | 2011 |
| 22 ½ | | 1121 | 1330 | 1533 | 1727 | 1922 | 2107 | 2291 | 2464 |
| 24 ½ | | 1344 | 1595 | 1840 | 2074 | 2309 | 2532 | 2754 | 2964 |
| 26 ½ | | 1588 | 1886 | 2175 | 2453 | 2732 | 2997 | 3260 | 3510 |
| 28 ½ | | 1852 | 2200 | 2539 | 2864 | 3190 | 3501 | 3809 | 4102 |
| 30 ½ | | 2137 | 2539 | 2930 | 3306 | 3684 | 4044 | 4401 | 4741 |
| 32 ½ | | 2443 | 2902 | 3350 | 3781 | 4214 | 4626 | 5036 | 5427 |
| 34 ½ | | 2768 | 3290 | 3798 | 4288 | 4780 | 5248 | 5714 | 6159 |
| 36 ½ | | 3115 | 3702 | 4275 | 4827 | 5381 | 5909 | 6435 | 6938 |
| 38 ½ | | 3482 | 4139 | 4779 | 5398 | 6019 | 6610 | 7199 | 7763 |
| 40 ½ | | 3869 | 4600 | 5312 | 6001 | 6692 | 7350 | 8005 | 8634 |
| 42 ½ | | 4277 | 5085 | 5873 | 6636 | 7400 | 8129 | 8855 | 9552 |
| 44 ½ | | 4705 | 5595 | 6463 | 7303 | 8145 | 8948 | 9748 | 10517 |
| 46 ½ | | 5153 | 6129 | 7080 | 8001 | 8925 | 9806 | 10683 | 11527 |
| 48 ½ | | 5623 | 6687 | 7726 | 8732 | 9741 | 10703 | 11662 | 12585 |
| 50 ½ | | 6112 | 7270 | 8400 | 9495 | 10593 | 11640 | 12684 | 13688 |
| 52 ½ | | 6623 | 7878 | 9103 | 12090 | 11481 | 12616 | 13748 | 14839 |
| 54 ½ | | 7153 | 8509 | 9833 | 11117 | 12404 | 13632 | 14856 | 16035 |
| 56 ½ | | 7704 | 9165 | 10592 | 11976 | 13363 | 14687 | 16006 | 17279 |
| 58 ½ | | 8276 | 9846 | 11379 | 12867 | 14358 | 15781 | 17199 | 18569 |
| 60 ½ | | 8868 | 10551 | 12194 | 13790 | 15389 | 16914 | 18436 | 19905 |
| 62 ½ | | 9481 | 11280 | 13038 | 14744 | 16455 | 18087 | 19715 | 21288 |
| t″ | | I Axis Y - Y | | | | | | | |
| 0″ | | 52 3 | 62 7 | 73 1 | 84 0 | 94 6 | 105 0 | 115 5 | 126.9 |
| ¼ | | 56 5 | 67 8 | 79 1 | 90 9 | 102 4 | 113 7 | 125 1 | 137.4 |
| 5/16 | | 57 6 | 69 2 | 80 7 | 92 7 | 104 4 | 115 9 | 127 6 | 140.1 |
| 3/8 | | 58 8 | 70 5 | 82 2 | 94 6 | 106 5 | 118 2 | 130 1 | 142 9 |
| 7/16 | | 59 9 | 71.9 | 83 9 | 96.4 | 108 6 | 120 6 | 132.7 | 145 8 |
| ½ | | 61.1 | 73.3 | 85 5 | 98 3 | 110 7 | 123 0 | 135.3 | 148.6 |
| 9/16 | | 62.3 | 74 7 | 87 2 | 100 2 | 112 9 | 125 4 | 138 0 | 151.6 |
| 5/8 | | 63.5 | 76 2 | 88.9 | 102 2 | 115.1 | 127.8 | 140.7 | 154.6 |
| ¾ | | 65.9 | 79.2 | 92.4 | 106 2 | 119 6 | 132.9 | 146 2 | 160 6 |

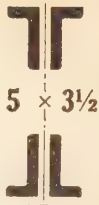



# MOMENTS OF INERTIA OF FOUR ANGLES

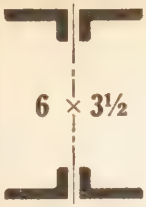
## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 5″ × 3 ½″ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 5/16 | 3/8 | 7/16 | ½ | 9/16 | 5/8 | 11/16 | ¾ |
| 4 | Area | 10 24 | 12 20 | 14 12 | 16 00 | 17 88 | 19 68 | 21.48 | 23 24 |
| L's | Weight | 34.8 | 41.6 | 48 0 | 54 4 | 60 8 | 67 2 | 73 2 | 79 2 |
| d″ | | I Axis X - X | | | | | | | |
| 10 ½ | | 164 | 193 | 221 | 246 | 272 | 296 | 320 | 340 |
| 12 ½ | | 249 | 294 | 337 | 377 | 418 | 456 | 493 | 526 |
| 14 ½ | | 354 | 419 | 482 | 540 | 599 | 654 | 709 | 759 |
| 16 ½ | | 481 | 569 | 654 | 735 | 817 | 892 | 968 | 1038 |
| 18 ½ | | 627 | 743 | 856 | 962 | 1070 | 1170 | 1270 | 1363 |
| 20 ½ | | 794 | 942 | 1085 | 1221 | 1357 | 1487 | 1615 | 1735 |
| 22 ½ | | 982 | 1165 | 1342 | 1511 | 1682 | 1843 | 2003 | 2153 |
| 24 ½ | | 1190 | 1412 | 1628 | 1834 | 2042 | 2239 | 2434 | 2618 |
| 26 ½ | | 1419 | 1684 | 1942 | 2189 | 2438 | 2674 | 2908 | 3129 |
| 28 ½ | | 1668 | 1980 | 2284 | 2576 | 2869 | 3148 | 3424 | 3687 |
| 30 ½ | | 1937 | 2301 | 2655 | 2995 | 3337 | 3661 | 3984 | 4291 |
| 32 ½ | | 2227 | 2646 | 3054 | 3446 | 3840 | 4214 | 4587 | 4942 |
| 34 ½ | | 2538 | 3015 | 3481 | 3929 | 4379 | 4807 | 5233 | 5639 |
| 36 ½ | | 2869 | 3409 | 3936 | 4444 | 4953 | 5439 | 5921 | 6383 |
| 38 ½ | | 3220 | 3827 | 4419 | 4990 | 5564 | 6110 | 6653 | 7173 |
| 40 ½ | | 3592 | 4270 | 4931 | 5569 | 6210 | 6820 | 7427 | 8010 |
| 42 ½ | | 3984 | 4737 | 5471 | 6180 | 6892 | 7570 | 8245 | 8893 |
| 44 ½ | | 4397 | 5228 | 6039 | 6823 | 7610 | 8359 | 9105 | 9822 |
| 46 ½ | | 4831 | 5744 | 6636 | 7498 | 8363 | 9188 | 10009 | 10798 |
| 48 ½ | | 5284 | 6285 | 7260 | 8205 | 9152 | 10055 | 10955 | 11821 |
| 50 ½ | | 5759 | 6849 | 7913 | 8944 | 9977 | 10963 | 11945 | 12890 |
| 52 ½ | | 6254 | 7438 | 8594 | 9715 | 10838 | 11909 | 12977 | 14005 |
| 54 ½ | | 6769 | 8052 | 9304 | 10518 | 11734 | 12895 | 14052 | 15167 |
| 56 ½ | | 7305 | 8689 | 10041 | 11352 | 12667 | 13921 | 15170 | 16376 |
| 58 ½ | | 7861 | 9352 | 10807 | 12219 | 13635 | 14985 | 16332 | 17631 |
| 60 ½ | | 8437 | 10038 | 11601 | 13118 | 14639 | 16089 | 17536 | 18932 |
| 62 ½ | | 9035 | 10749 | 12424 | 14049 | 15678 | 17233 | 18783 | 20280 |
| 64 ½ | | 9652 | 11485 | 13274 | 15012 | 16753 | 18416 | 20073 | 21675 |
| 66 ½ | | 10291 | 12245 | 14153 | 16007 | 17864 | 19638 | 21406 | 23116 |
| 68 ½ | | 10949 | 13029 | 15060 | 17034 | 19011 | 20899 | 22782 | 24603 |
| 70 ½ | | 11628 | 13837 | 15996 | 18093 | 20194 | 22200 | 24201 | 26137 |
| 72 ½ | | 12328 | 14670 | 16959 | 19183 | 21412 | 23540 | 25663 | 27717 |
| 74 ½ | | 13048 | 15528 | 17951 | 20306 | 22666 | 24920 | 27168 | 29344 |
| 76 ½ | | 13789 | 16409 | 18971 | 21461 | 23956 | 26339 | 28716 | 31017 |
| t″ | | I Axis Y - Y | | | | | | | |
| 0″ | | 18.1 | 21.7 | 25 5 | 29 4 | 33 3 | 37 1 | 41 0 | 45 4 |
| 1/4 | | 20.4 | 24 6 | 28 8 | 33 3 | 37 7 | 42 1 | 46 6 | 51 6 |
| 5/16 | | 21.0 | 25 3 | 29 7 | 34 4 | 38 9 | 43 4 | 48 0 | 53 3 |
| 3/8 | | 21.7 | 26.1 | 30 6 | 35 5 | 40 1 | 44 8 | 49 6 | 55 0 |
| 7/16 | | 22.4 | 26 9 | 31.6 | 36 6 | 41.4 | 46 2 | 51 2 | 56 7 |
| ½ | | 23.0 | 27 8 | 32 5 | 37 7 | 42 7 | 47 7 | 52 8 | 58 5 |
| 9/16 | | 23.7 | 28 6 | 33 6 | 38 9 | 44 0 | 49 2 | 54 4 | 60 4 |
| 5/8 | | 24.5 | 29 5 | 34 6 | 40 1 | 45 4 | 50 7 | 56 1 | 62 2 |
| ¾ | | 26.0 | 31 3 | 36 8 | 42 6 | 48 2 | 53 9 | 59 7 | 66 1 |



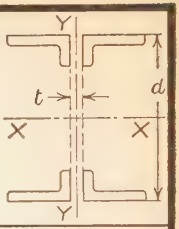
# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

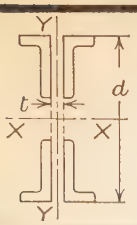
**6 × 3½**

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 6″ × 3 ½″ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 |
| 4 | Area | 13.68 | 15 88 | 18 00 | 20.12 | 22 20 | 24 24 | 26 24 | 28 24 | 30 20 |
| L's | Weight | 46.8 | 54.0 | 61.2 | 68 4 | 75 6 | 82 4 | 89 6 | 96 0 | 102 8 |
| d″ | | I Axis X - X | | | | | | | | |
| 7 ½ | | 133 | 153 | 170 | 187 | 203 | 219 | 232 | 246 | 260 |
| 8 ½ | | 177 | 203 | 228 | 250 | 272 | 294 | 313 | 332 | 351 |
| 9 ½ | | 228 | 262 | 294 | 323 | 353 | 381 | 406 | 433 | 458 |
| 10 ½ | | 285 | 328 | 369 | 406 | 444 | 481 | 513 | 547 | 579 |
| 12 ½ | | 421 | 485 | 546 | 603 | 660 | 716 | 766 | 818 | 868 |
| 14 ½ | | 584 | 674 | 759 | 840 | 921 | 999 | 1071 | 1146 | 1217 |
| 16 ½ | | 775 | 894 | 1008 | 1117 | 1226 | 1331 | 1429 | 1530 | 1627 |
| 18 ½ | | 992 | 1146 | 1293 | 1435 | 1576 | 1712 | 1840 | 1970 | 2097 |
| 20 ½ | | 1238 | 1430 | 1614 | 1793 | 1969 | 2141 | 2303 | 2467 | 2627 |
| 22 ½ | | 1510 | 1746 | 1971 | 2191 | 2408 | 2619 | 2818 | 3021 | 3218 |
| 24 ½ | | 1810 | 2094 | 2364 | 2629 | 2890 | 3145 | 3386 | 3631 | 3869 |
| 26 ½ | | 2137 | 2473 | 2794 | 3107 | 3417 | 3719 | 4006 | 4297 | 4580 |
| 28 ½ | | 2492 | 2884 | 3259 | 3626 | 3989 | 4342 | 4679 | 5020 | 5352 |
| 30 ½ | | 2874 | 3326 | 3760 | 4185 | 4605 | 5013 | 5404 | 5800 | 6185 |
| 32 ½ | | 3283 | 3801 | 4297 | 4784 | 5265 | 5733 | 6182 | 6636 | 7077 |
| 34 ½ | | 3720 | 4307 | 4870 | 5424 | 5969 | 6502 | 7012 | 7528 | 8030 |
| 36 ½ | | 4184 | 4845 | 5479 | 6103 | 6718 | 7319 | 7895 | 8477 | 9044 |
| 38 ½ | | 4675 | 5415 | 6124 | 6823 | 7512 | 8184 | 8830 | 9482 | 10118 |
| 40 ½ | | 5194 | 6017 | 6805 | 7583 | 8350 | 9098 | 9818 | 10544 | 11252 |
| 42 ½ | | 5740 | 6650 | 7523 | 8384 | 9232 | 10060 | 10858 | 11662 | 12447 |
| 44 ½ | | 6313 | 7315 | 8276 | 9224 | 10159 | 11071 | 11951 | 12837 | 13702 |
| 46 ½ | | 6914 | 8012 | 9065 | 10105 | 11130 | 12130 | 13096 | 14068 | 15017 |
| 48 ½ | | 7542 | 8740 | 9890 | 11026 | 12145 | 13238 | 14293 | 15356 | 16393 |
| 50 ½ | | 8198 | 9501 | 10751 | 11988 | 13205 | 14394 | 15543 | 16700 | 17830 |
| 52 ½ | | 8881 | 10293 | 11648 | 12989 | 14309 | 15599 | 16846 | 18101 | 19326 |
| 54 ½ | | 9591 | 11117 | 12581 | 14031 | 15458 | 16852 | 18201 | 19558 | 20883 |
| 56 ½ | | 10329 | 11972 | 13550 | 15113 | 16651 | 18154 | 19608 | 21072 | 22501 |
| 58 ½ | | 11094 | 12860 | 14556 | 16235 | 17888 | 19504 | 21068 | 22642 | 24179 |
| 60 ½ | | 11886 | 13779 | 15597 | 17398 | 19170 | 20903 | 22581 | 24269 | 25917 |
| 62 ½ | | 12706 | 14730 | 16674 | 18601 | 20496 | 22350 | 24146 | 25952 | 27716 |
| 64 ½ | | 13553 | 15712 | 17787 | 19844 | 21867 | 23845 | 25763 | 27691 | 29575 |
| 66 ½ | | 14427 | 16727 | 18936 | 21127 | 23282 | 25390 | 27433 | 29487 | 31495 |
| 68 ½ | | 15329 | 17773 | 20121 | 22450 | 24741 | 26982 | 29156 | 31340 | 33474 |
| 70 ½ | | 16258 | 18851 | 21342 | 23814 | 26245 | 28623 | 30930 | 33249 | 35515 |
| 72 ½ | | 17215 | 19960 | 22599 | 25218 | 27793 | 30313 | 32758 | 35214 | 37615 |
| 74 ½ | | 18199 | 21102 | 23892 | 26662 | 29386 | 32051 | 34638 | 37236 | 39777 |
| 76 ½ | | 19210 | 22275 | 25222 | 28147 | 31023 | 33837 | 36570 | 39315 | 41998 |
| 78 ½ | | 20248 | 23480 | 26587 | 29671 | 32704 | 35672 | 38555 | 41450 | 44280 |
| 80 ½ | | 21314 | 24717 | 27988 | 31236 | 34430 | 37556 | 40592 | 43641 | 46622 |
| 82 ½ | | 22408 | 25985 | 29425 | 32841 | 36200 | 39488 | 42682 | 45889 | 49025 |
| 84 ½ | | 23528 | 27286 | 30898 | 34487 | 38015 | 41468 | 44824 | 48193 | 51488 |
| t″ | | I Axis Y - Y | | | | | | | | |
| 0″ | | 108.4 | 126.4 | 144.2 | 163.1 | 181.0 | 199.0 | 218 1 | 236.2 | 254.4 |
| 3/8 | | 119.3 | 139.3 | 158.9 | 179.7 | 199.6 | 219.4 | 240 4 | 260.5 | 280 6 |
| 7/16 | | 121.2 | 141.5 | 161.5 | 182.6 | 202.8 | 223.0 | 244.3 | 264.8 | 285.2 |
| 1/2 | | 123.2 | 143.8 | 164.1 | 185.5 | 206.1 | 226.6 | 248.3 | 269.1 | 289.8 |
| 5/8 | | 127.1 | 148.4 | 169.4 | 191.6 | 212.8 | 233.9 | 256.4 | 277 8 | 299.2 |
| 3/4 | | 131.2 | 153.2 | 174.8 | 197.7 | 219.6 | 241.5 | 264 7 | 286.8 | 308.9 |
| 7/8 | | 135.4 | 158.1 | 180.4 | 204.1 | 226.7 | 249.2 | 273.1 | 296 0 | 318.8 |
| 1″ | | 139.7 | 163.1 | 186.2 | 210.5 | 233.9 | 257.2 | 281.8 | 305.4 | 329.0 |
| 1 1/8 | | 144.1 | 168 3 | 192.1 | 217.2 | 241.3 | 265 3 | 290.7 | 315.1 | 339.4 |



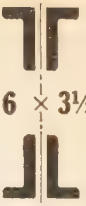

# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.

AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.



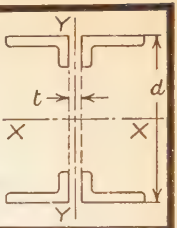

| Size | | 6″ × 3 ½″ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 |
| 4 | Area | 13 68 | 15 88 | 18 00 | 20.12 | 22 20 | 24 24 | 26 24 | 28 24 | 30 20 |
| L's | Weight | 46 8 | 54.0 | 61 2 | 68 4 | 75.6 | 82.4 | 89.6 | 96.0 | 102.8 |
| d″ | | I Axis X - X | | | | | | | | |
| 12 ½ | | 294 | 338 | 379 | 418 | 457 | 494 | 528 | 563 | 596 |
| 14 ½ | | 423 | 487 | 547 | 605 | 662 | 717 | 768 | 820 | 870 |
| 16 ½ | | 579 | 667 | 752 | 832 | 912 | 989 | 1060 | 1133 | 1204 |
| 18 ½ | | 763 | 880 | 992 | 1099 | 1206 | 1309 | 1405 | 1503 | 1598 |
| 20 ½ | | 974 | 1124 | 1268 | 1407 | 1544 | 1677 | 1802 | 1930 | 2053 |
| 22 ½ | | 1212 | 1400 | 1580 | 1754 | 1927 | 2094 | 2252 | 2412 | 2568 |
| 24 ½ | | 1477 | 1708 | 1928 | 2142 | 2354 | 2560 | 2754 | 2952 | 3144 |
| 26 ½ | | 1771 | 2047 | 2312 | 2570 | 2825 | 3074 | 3309 | 3548 | 3780 |
| 28 ½ | | 2091 | 2419 | 2732 | 3039 | 3341 | 3636 | 3916 | 4200 | 4476 |
| 30 ½ | | 2439 | 2822 | 3188 | 3547 | 3902 | 4247 | 4576 | 4909 | 5233 |
| 32 ½ | | 2814 | 3257 | 3681 | 4096 | 4506 | 4906 | 5288 | 5674 | 6050 |
| 34 ½ | | 3216 | 3723 | 4209 | 4685 | 5156 | 5614 | 6053 | 6496 | 6928 |
| 36 ½ | | 3646 | 4221 | 4773 | 5315 | 5849 | 6370 | 6870 | 7374 | 7866 |
| 38 ½ | | 4103 | 4752 | 5373 | 5984 | 6587 | 7175 | 7739 | 8309 | 8864 |
| 40 ½ | | 4588 | 5313 | 6009 | 6694 | 7369 | 8028 | 8661 | 9300 | 9923 |
| 42 ½ | | 5100 | 5907 | 6681 | 7444 | 8196 | 8930 | 9636 | 10348 | 11042 |
| 44 ½ | | 5639 | 6532 | 7389 | 8235 | 9067 | 9880 | 10663 | 11452 | 12222 |
| 46 ½ | | 6206 | 7189 | 8133 | 9065 | 9983 | 10879 | 11742 | 12613 | 13462 |
| 48 ½ | | 6800 | 7878 | 8914 | 9936 | 10943 | 11926 | 12874 | 13830 | 14762 |
| 50 ½ | | 7421 | 8599 | 9730 | 10847 | 11947 | 13022 | 14059 | 15104 | 16123 |
| 52 ½ | | 8070 | 9351 | 10582 | 11798 | 12996 | 14166 | 15296 | 16434 | 17544 |
| 54 ½ | | 8746 | 10135 | 11470 | 12790 | 14089 | 15358 | 16585 | 17820 | 19026 |
| 56 ½ | | 9449 | 10951 | 12394 | 13821 | 15226 | 16599 | 17927 | 19263 | 20568 |
| 58 ½ | | 10180 | 11799 | 13354 | 14893 | 16408 | 17889 | 19322 | 20763 | 22170 |
| 60 ½ | | 10938 | 12678 | 14350 | 16006 | 17635 | 19227 | 20769 | 22319 | 23833 |
| 62 ½ | | 11724 | 13590 | 15382 | 17158 | 18905 | 20614 | 22268 | 23931 | 25556 |
| 64 ½ | | 12536 | 14533 | 16450 | 18351 | 20220 | 22049 | 23820 | 25600 | 27340 |
| 66 ½ | | 13377 | 15507 | 17555 | 19584 | 21580 | 23532 | 25424 | 27326 | 29184 |
| 68 ½ | | 14244 | 16514 | 18695 | 20857 | 22984 | 25064 | 27081 | 29108 | 31088 |
| 70 ½ | | 15139 | 17552 | 19871 | 22170 | 24432 | 26645 | 28790 | 30946 | 33053 |
| 72 ½ | | 16061 | 18622 | 21083 | 23524 | 25925 | 28273 | 30552 | 32841 | 35078 |
| 74 ½ | | 17011 | 19724 | 22331 | 24918 | 27462 | 29951 | 32366 | 34792 | 37164 |
| 76 ½ | | 17988 | 20857 | 23615 | 26352 | 29044 | 31677 | 34233 | 36800 | 39310 |
| 78 ½ | | 18993 | 22023 | 24935 | 27827 | 30670 | 33451 | 36152 | 38865 | 41516 |
| 80 ½ | | 20024 | 23220 | 26291 | 29341 | 32340 | 35274 | 38124 | 40986 | 43783 |
| 82 ½ | | 21083 | 24448 | 27684 | 30896 | 34055 | 37145 | 40148 | 43163 | 46110 |
| 84 ½ | | 22170 | 25709 | 29112 | 32491 | 35814 | 39065 | 42224 | 45397 | 48498 |
| 90 ½ | | 25593 | 29681 | 33612 | 37518 | 41358 | 45115 | 48769 | 52437 | 56023 |
| 96 ½ | | 29263 | 33939 | 38436 | 42907 | 47301 | 51602 | 55786 | 59985 | 64092 |
| 102 ½ | | 33179 | 38483 | 43585 | 48658 | 53644 | 58525 | 63276 | 68042 | 72705 |
| 108 ½ | | 37342 | 43313 | 49057 | 54771 | 60387 | 65884 | 71237 | 76607 | 81861 |
| 114 ½ | | 41750 | 48429 | 54853 | 61247 | 67529 | 73680 | 79672 | 85681 | 91560 |
| t″ | | I Axis Y - Y | | | | | | | | |
| 0″ | | 21.9 | 25.7 | 29.4 | 33 6 | 37.5 | 41.5 | 46.1 | 50 3 | 54 6 |
| 3/8 | | 26.4 | 31.0 | 35.6 | 40 8 | 45 6 | 50.5 | 56 1 | 61 3 | 66 7 |
| 7/16 | | 27.3 | 32.0 | 36 8 | 42 1 | 47 1 | 52.2 | 58 0 | 63 4 | 68 9 |
| 1/2 | | 28.2 | 33.1 | 38 0 | 43.5 | 48 7 | 53.9 | 59 9 | 65.5 | 71 1 |
| 5/8 | | 30.0 | 35.2 | 40 5 | 46 3 | 51 9 | 57.5 | 63 9 | 69 8 | 75 9 |
| 3/4 | | 31.9 | 37.5 | 43 1 | 49 4 | 55 3 | 61.3 | 68 0 | 74 4 | 80 8 |
| 7/8 | | 34.0 | 40.0 | 45.9 | 52.6 | 58 9 | 65.2 | 72 4 | 79 2 | 86 0 |
| 1″ | | 36.1 | 42.5 | 48 8 | 55.9 | 62 6 | 69.4 | 77 0 | 84 2 | 91 5 |
| 1 1/8 | | 38.4 | 45.2 | 51 9 | 59.4 | 66 5 | 73.7 | 81 7 | 89 4 | 97 1 |

# MOMENTS OF INERTIA OF FOUR ANGLES

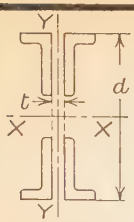
## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 6″ × 4″ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 |
| 4 | Area | 14.44 | 16.72 | 19.00 | 21.24 | 23 44 | 25.60 | 27.76 | 29.88 | 31.92 |
| L's | Weight | 49 2 | 57 2 | 64 8 | 72 4 | 80 0 | 87.2 | 94.4 | 101.6 | 108.8 |
| d″ | | I Axis X - X | | | | | | | | |
| 8 | 1/2 | 178 | 203 | 227 | 251 | 273 | 293 | 314 | 333 | 352 |
| 9 | 1/2 | 229 | 263 | 294 | 325 | 354 | 381 | 409 | 435 | 460 |
| 10 | 1/2 | 288 | 330 | 370 | 409 | 448 | 482 | 517 | 552 | 583 |
| 12 | 1/2 | 427 | 490 | 551 | 611 | 669 | 722 | 777 | 829 | 879 |
| 14 | 1/2 | 595 | 684 | 770 | 855 | 937 | 1013 | 1092 | 1167 | 1238 |
| 16 | 1/2 | 791 | 911 | 1027 | 1141 | 1252 | 1356 | 1462 | 1564 | 1662 |
| 18 | 1/2 | 1017 | 1171 | 1321 | 1470 | 1614 | 1750 | 1888 | 2022 | 2149 |
| 20 | 1/2 | 1271 | 1465 | 1654 | 1841 | 2023 | 2195 | 2369 | 2539 | 2700 |
| 22 | 1/2 | 1555 | 1793 | 2025 | 2255 | 2478 | 2691 | 2906 | 3115 | 3315 |
| 24 | 1/2 | 1867 | 2154 | 2434 | 2711 | 2981 | 3238 | 3498 | 3752 | 3993 |
| 26 | 1/2 | 2208 | 2548 | 2881 | 3210 | 3530 | 3837 | 4146 | 4448 | 4736 |
| 28 | 1/2 | 2578 | 2976 | 3366 | 3751 | 4127 | 4486 | 4850 | 5204 | 5542 |
| 30 | 1/2 | 2977 | 3437 | 3889 | 4335 | 4770 | 5187 | 5609 | 6020 | 6412 |
| 32 | 1/2 | 3404 | 3931 | 4450 | 4961 | 5460 | 5939 | 6423 | 6895 | 7346 |
| 34 | 1/2 | 3861 | 4459 | 5048 | 5629 | 6197 | 6743 | 7293 | 7830 | 8344 |
| 36 | 1/2 | 4346 | 5021 | 5685 | 6341 | 6981 | 7597 | 8219 | 8825 | 9406 |
| 38 | 1/2 | 4861 | 5616 | 6360 | 7094 | 7811 | 8503 | 9200 | 9880 | 10531 |
| 40 | 1/2 | 5404 | 6244 | 7073 | 7890 | 8689 | 9460 | 10236 | 10995 | 11720 |
| 42 | 1/2 | 5976 | 6906 | 7824 | 8729 | 9613 | 10468 | 11328 | 12169 | 12974 |
| 44 | 1/2 | 6577 | 7601 | 8613 | 9610 | 10585 | 11527 | 12476 | 13403 | 14291 |
| 46 | 1/2 | 7207 | 8330 | 9440 | 10533 | 11603 | 12638 | 13679 | 14697 | 15671 |
| 48 | 1/2 | 7866 | 9092 | 10305 | 11499 | 12668 | 13800 | 14938 | 16050 | 17116 |
| 50 | 1/2 | 8553 | 9887 | 11207 | 12508 | 13780 | 15012 | 16252 | 17464 | 18625 |
| 52 | 1/2 | 9270 | 10716 | 12148 | 13559 | 14939 | 16277 | 17622 | 18937 | 20197 |
| 54 | 1/2 | 10015 | 11579 | 13127 | 14652 | 16145 | 17592 | 19047 | 20470 | 21833 |
| 56 | 1/2 | 10789 | 12475 | 14144 | 15788 | 17397 | 18958 | 20527 | 22062 | 23533 |
| 58 | 1/2 | 11593 | 13404 | 15199 | 16967 | 18697 | 20376 | 22064 | 23715 | 25297 |
| 60 | 1/2 | 12425 | 14367 | 16292 | 18187 | 20043 | 21845 | 23655 | 25427 | 27125 |
| 62 | 1/2 | 13286 | 15363 | 17423 | 19451 | 21437 | 23365 | 25303 | 27199 | 29017 |
| 64 | 1/2 | 14175 | 16392 | 18592 | 20757 | 22877 | 24937 | 27006 | 29030 | 30972 |
| 66 | 1/2 | 15094 | 17455 | 19799 | 22105 | 24364 | 26559 | 28764 | 30922 | 32991 |
| 68 | 1/2 | 16042 | 18552 | 21043 | 23496 | 25898 | 28233 | 30578 | 32873 | 35074 |
| 70 | 1/2 | 17018 | 19682 | 22326 | 24929 | 27478 | 29958 | 32447 | 34885 | 37221 |
| 72 | 1/2 | 18023 | 20845 | 23647 | 26405 | 29106 | 31734 | 34372 | 36955 | 39432 |
| 74 | 1/2 | 19057 | 22042 | 25006 | 27923 | 30781 | 33561 | 36352 | 39086 | 41707 |
| 76 | 1/2 | 20121 | 23272 | 26403 | 29484 | 32502 | 35440 | 38388 | 41276 | 44045 |
| 78 | 1/2 | 21212 | 24536 | 27838 | 31087 | 34270 | 37370 | 40480 | 43526 | 46447 |
| 80 | 1/2 | 22333 | 25833 | 29311 | 32733 | 36086 | 39350 | 42627 | 45836 | 48914 |
| 82 | 1/2 | 23483 | 27164 | 30822 | 34421 | 37948 | 41383 | 44829 | 48205 | 51444 |
| 84 | 1/2 | 24662 | 28528 | 32370 | 36151 | 39857 | 43466 | 47087 | 50634 | 54037 |
| 90 | 1/2 | 28371 | 32821 | 37245 | 41598 | 45865 | 50023 | 54194 | 58281 | 62202 |
| 96 | 1/2 | 32340 | 37414 | 42462 | 47427 | 52295 | 57041 | 61801 | 66465 | 70941 |
| 102 | 1/2 | 36569 | 43309 | 48020 | 53639 | 59147 | 64520 | 69908 | 75187 | 80254 |
| t″ | | I Axis Y - Y | | | | | | | | |
| 0″ | | 108 2 | 126 1 | 144 8 | 162 9 | 180 9 | 200 1 | 218 1 | 236.4 | 254 4 |
| 3/8 | | 119 2 | 138 9 | 158 7 | 179 6 | 199 5 | 220 6 | 240 8 | 261.0 | 280.9 |
| 7/16 | | 171 2 | 141 2 | 162 3 | 182 5 | 202 8 | 224 2 | 244 7 | 265.3 | 285.5 |
| 1/2 | | 123 1 | 143 5 | 164.9 | 185 5 | 206 1 | 227 9 | 248.7 | 269 6 | 290.2 |
| 5/8 | | 127 1 | 148 2 | 170.3 | 191 6 | 212 9 | 235 4 | 256 9 | 278 5 | 299.8 |
| 3/4 | | 131 3 | 153 0 | 175.9 | 197 9 | 219 9 | 243 1 | 265 4 | 287.6 | 309 6 |
| 7/8 | | 135 5 | 157 9 | 181.6 | 204 3 | 227 0 | 251.0 | 274 0 | 297.0 | 319.7 |
| 1″ | | 139 8 | 163 0 | 187.4 | 210 9 | 234.3 | 259.1 | 282.8 | 306.6 | 330 0 |
| 1 | 1/8 | 144 3 | 168 2 | 193.4 | 217.6 | 241.8 | 267 3 | 291.9 | 316.4 | 340.6 |
| 1 | 1/4 | 148 9 | 173 6 | 199.5 | 224 5 | 249 5 | 275 8 | 301 2 | 326 5 | 351.4 |




# MOMENTS OF INERTIA OF FOUR ANGLES

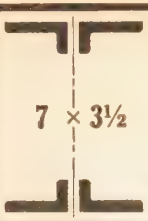
## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.

AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 6″ × 4″ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 |
| 4 | Area | 14 44 | 16.72 | 19 00 | 21.24 | 23 44 | 25 60 | 27 76 | 29 88 | 31 92 |
| L's | Weight | 49 2 | 57.2 | 64 8 | 72 4 | 80.0 | 87.2 | 94 4 | 101 6 | 108.8 |
| d″ | | I Axis X - X | | | | | | | | |
| 12 1/2 | | 322 | 370 | 414 | 459 | 502 | 541 | 581 | 619 | 655 |
| 14 1/2 | | 461 | 530 | 595 | 660 | 723 | 781 | 840 | 897 | 951 |
| 16 1/2 | | 629 | 723 | 814 | 904 | 991 | 1072 | 1155 | 1235 | 1311 |
| 18 1/2 | | 825 | 950 | 1071 | 1190 | 1306 | 1415 | 1525 | 1632 | 1734 |
| 20 1/2 | | 1051 | 1211 | 1366 | 1519 | 1668 | 1808 | 1951 | 2089 | 2221 |
| 22 1/2 | | 1305 | 1505 | 1699 | 1890 | 2077 | 2253 | 2432 | 2606 | 2772 |
| 24 1/2 | | 1589 | 1832 | 2070 | 2304 | 2533 | 2749 | 2969 | 3183 | 3387 |
| 26 1/2 | | 1901 | 2193 | 2479 | 2760 | 3035 | 3297 | 3562 | 3819 | 4066 |
| 28 1/2 | | 2242 | 2587 | 2925 | 3259 | 3585 | 3895 | 4210 | 4516 | 4808 |
| 30 1/2 | | 2612 | 3015 | 3410 | 3800 | 4181 | 4545 | 4913 | 5272 | 5614 |
| 32 1/2 | | 3011 | 3476 | 3933 | 4384 | 4824 | 5246 | 5672 | 6087 | 6484 |
| 34 1/2 | | 3439 | 3971 | 4494 | 5010 | 5514 | 5998 | 6486 | 6963 | 7418 |
| 36 1/2 | | 3895 | 4499 | 5093 | 5679 | 6251 | 6801 | 7356 | 7898 | 8416 |
| 38 1/2 | | 4381 | 5060 | 5730 | 6390 | 7035 | 7656 | 8282 | 8893 | 9478 |
| 40 1/2 | | 4895 | 5655 | 6405 | 7143 | 7866 | 8562 | 9263 | 9948 | 10603 |
| 42 1/2 | | 5438 | 6283 | 7118 | 7940 | 8743 | 9519 | 10300 | 11062 | 11793 |
| 44 1/2 | | 6010 | 6945 | 7868 | 8778 | 9668 | 10527 | 11392 | 12237 | 13046 |
| 46 1/2 | | 6611 | 7640 | 8657 | 9659 | 10529 | 11586 | 12539 | 13471 | 14363 |
| 48 1/2 | | 7241 | 8369 | 9484 | 10583 | 11658 | 12697 | 13742 | 14764 | 15744 |
| 50 1/2 | | 7900 | 9131 | 10349 | 11549 | 12722 | 13858 | 15001 | 16118 | 17189 |
| 52 1/2 | | 8588 | 9927 | 11252 | 12557 | 13834 | 15071 | 16315 | 17531 | 18697 |
| 54 1/2 | | 9304 | 10756 | 12193 | 13608 | 14993 | 16335 | 17685 | 19004 | 20269 |
| 56 1/2 | | 10049 | 11618 | 13172 | 14701 | 16199 | 17651 | 19110 | 20537 | 21906 |
| 58 1/2 | | 10824 | 12514 | 14189 | 15837 | 17452 | 19016 | 20591 | 22130 | 23606 |
| 60 1/2 | | 11627 | 13443 | 15244 | 17016 | 18751 | 20434 | 22127 | 23782 | 25370 |
| 62 1/2 | | 12459 | 14406 | 16336 | 18237 | 20097 | 21903 | 23719 | 25494 | 27197 |
| 64 1/2 | | 13320 | 15420 | 17467 | 19500 | 21491 | 23423 | 25366 | 27266 | 29089 |
| 66 1/2 | | 14210 | 16432 | 18636 | 20806 | 22931 | 24994 | 27069 | 29098 | 31045 |
| 68 1/2 | | 15128 | 17495 | 19843 | 22154 | 24418 | 26617 | 28827 | 30989 | 33064 |
| 70 1/2 | | 16076 | 18591 | 21088 | 23545 | 25952 | 28291 | 30641 | 32940 | 35147 |
| 72 1/2 | | 17052 | 19721 | 22371 | 24978 | 27533 | 30016 | 32510 | 34951 | 37294 |
| 74 1/2 | | 18058 | 20885 | 23692 | 26454 | 29160 | 31792 | 34435 | 37022 | 39505 |
| 76 1/2 | | 19092 | 22082 | 25051 | 27972 | 30835 | 33619 | 36416 | 39152 | 41780 |
| 78 1/2 | | 20155 | 23312 | 26447 | 29533 | 32556 | 35498 | 38452 | 41343 | 44118 |
| 80 1/2 | | 21247 | 24576 | 27882 | 31136 | 34325 | 37427 | 40543 | 43593 | 46520 |
| 82 1/2 | | 22368 | 25873 | 29355 | 32782 | 36140 | 39408 | 42690 | 45902 | 48986 |
| 84 1/2 | | 23517 | 27203 | 30866 | 34470 | 38002 | 41440 | 44892 | 48272 | 51516 |
| 90 1/2 | | 27140 | 31396 | 35627 | 39789 | 43869 | 47844 | 51833 | 55739 | 59489 |
| 96 1/2 | | 31022 | 35889 | 40729 | 45491 | 50159 | 54708 | 59273 | 63744 | 68037 |
| 102 1/2 | | 35164 | 40683 | 46174 | 51575 | 56870 | 62034 | 67213 | 72286 | 77159 |
| 108 1/2 | | 39566 | 45779 | 51961 | 58041 | 64003 | 69820 | 75653 | 81367 | 86856 |
| t″ | | I Axis Y - Y | | | | | | | | |
| 0″ | | 32.4 | 37.8 | 43.7 | 49.3 | 54.9 | 61.2 | 67.1 | 73.1 | 79.0 |
| 3/8 | | 38.0 | 44.4 | 51.4 | 58.1 | 64.8 | 72.3 | 79.3 | 86.5 | 93.6 |
| 7/16 | | 39.0 | 45.6 | 52.8 | 59.7 | 66.6 | 74.3 | 81.5 | 88.9 | 96.2 |
| 1/2 | | 40.0 | 46.9 | 54.3 | 61.4 | 68.5 | 76.4 | 83.8 | 91.4 | 98.9 |
| 5/8 | | 42.2 | 49.5 | 57.3 | 64.8 | 72.3 | 80.7 | 88.5 | 96.5 | 104.5 |
| 3/4 | | 44.6 | 52.2 | 60.5 | 68.4 | 76.4 | 85.2 | 93.5 | 101.9 | 110.3 |
| 7/8 | | 47.0 | 55.1 | 63.8 | 72.1 | 80.6 | 89.8 | 98.6 | 107.6 | 116.4 |
| 1″ | | 49.5 | 58.0 | 67.3 | 76.1 | 85.0 | 94.7 | 104.0 | 113.4 | 122.8 |
| 1 1/8 | | 52.2 | 61.2 | 70.9 | 80.2 | 89.5 | 99.8 | 109.6 | 119.5 | 129.4 |
| 1 1/4 | | 55.0 | 64.4 | 74.6 | 84.4 | 94.3 | 105.1 | 115.4 | 125.8 | 136.2 |

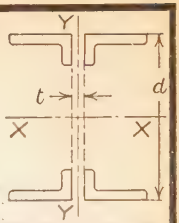



# MOMENTS OF INERTIA OF FOUR ANGLES

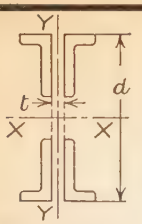
## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 7″ × 3 ½″ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ |
| 4 | Area | 15 20 | 17 60 | 20.00 | 22 36 | 24 68 | 27 00 | 29 24 | 31 48 | 33 68 | 35 88 | 38 00 |
| L's | Weight | 52 0 | 60 0 | 68.0 | 76 4 | 84 0 | 92 0 | 99 6 | 107 2 | 114 8 | 122 0 | 129 2 |
| d″ | | I Axis X - X | | | | | | | | | | |
| 8 ½ | | 202 | 231 | 258 | 286 | 311 | 335 | 358 | 381 | 403 | 422 | 441 |
| 9 ½ | | 260 | 297 | 333 | 368 | 402 | 433 | 465 | 495 | 524 | 550 | 576 |
| 10 ½ | | 324 | 372 | 417 | 462 | 505 | 545 | 585 | 624 | 662 | 695 | 729 |
| 12 ½ | | 477 | 548 | 616 | 684 | 749 | 810 | 871 | 930 | 988 | 1040 | 1094 |
| 14 ½ | | 660 | 759 | 855 | 950 | 1042 | 1129 | 1215 | 1299 | 1381 | 1457 | 1534 |
| 16 ½ | | 873 | 1006 | 1134 | 1260 | 1384 | 1501 | 1617 | 1731 | 1842 | 1946 | 2050 |
| 18 ½ | | 1117 | 1287 | 1452 | 1616 | 1775 | 1928 | 2078 | 2226 | 2370 | 2506 | 2642 |
| 20 ½ | | 1391 | 1604 | 1811 | 2016 | 2216 | 2408 | 2597 | 2784 | 2965 | 3139 | 3310 |
| 22 ½ | | 1696 | 1956 | 2210 | 2461 | 2706 | 2943 | 3175 | 3405 | 3628 | 3843 | 4054 |
| 24 ½ | | 2031 | 2343 | 2649 | 2951 | 3245 | 3532 | 3811 | 4088 | 4358 | 4618 | 4874 |
| 26 ½ | | 2396 | 2766 | 3128 | 3485 | 3834 | 4174 | 4506 | 4835 | 5157 | 5466 | 5770 |
| 28 ½ | | 2792 | 3223 | 3646 | 4064 | 4473 | 4871 | 5259 | 5645 | 6021 | 6385 | 6742 |
| 30 ½ | | 3219 | 3716 | 4205 | 4688 | 5160 | 5621 | 6071 | 6517 | 6953 | 7376 | 7790 |
| 32 ½ | | 3675 | 4244 | 4804 | 5357 | 5897 | 6426 | 6941 | 7453 | 7953 | 8439 | 8914 |
| 34 ½ | | 4162 | 4807 | 5443 | 6070 | 6683 | 7285 | 7870 | 8451 | 9020 | 9573 | 10114 |
| 36 ½ | | 4680 | 5406 | 6122 | 6828 | 7519 | 8197 | 8857 | 9513 | 10154 | 10780 | 11390 |
| 38 ½ | | 5227 | 6039 | 6840 | 7631 | 8404 | 9164 | 9902 | 10637 | 11356 | 12058 | 12742 |
| 40 ½ | | 5806 | 6708 | 7599 | 8478 | 9338 | 10184 | 11006 | 11825 | 12625 | 13408 | 14170 |
| 42 ½ | | 6414 | 7412 | 8398 | 9370 | 10322 | 11259 | 12169 | 13075 | 13961 | 14829 | 15674 |
| 44 ½ | | 7053 | 8151 | 9237 | 10307 | 11355 | 12388 | 13390 | 14389 | 15365 | 16322 | 17254 |
| 46 ½ | | 7723 | 8926 | 10116 | 11289 | 12438 | 13570 | 14670 | 15765 | 16836 | 17887 | 18910 |
| 48 ½ | | 8422 | 9735 | 11034 | 12315 | 13570 | 14807 | 16008 | 17204 | 18375 | 19524 | 20642 |
| 50 ½ | | 9153 | 10580 | 11993 | 13386 | 14751 | 16097 | 17404 | 18706 | 19981 | 21233 | 22450 |
| 52 ½ | | 9913 | 11460 | 12992 | 14502 | 15981 | 17442 | 18859 | 20272 | 21654 | 23013 | 24334 |
| 54 ½ | | 10704 | 12375 | 14031 | 15663 | 17261 | 18841 | 20373 | 21900 | 23394 | 24865 | 26294 |
| 56 ½ | | 11526 | 13326 | 15110 | 16868 | 18590 | 20293 | 21945 | 23591 | 25202 | 26789 | 28330 |
| 58 ½ | | 12377 | 14311 | 16228 | 18118 | 19969 | 21850 | 23575 | 25345 | 27078 | 28785 | 30442 |
| 60 ½ | | 13260 | 15332 | 17387 | 19412 | 21397 | 23360 | 25264 | 27162 | 29020 | 30852 | 32630 |
| 62 ½ | | 14172 | 16388 | 18586 | 20752 | 22874 | 24975 | 27011 | 29042 | 31030 | 32992 | 34895 |
| 64 ½ | | 15115 | 17479 | 19825 | 22136 | 24401 | 26644 | 28817 | 30985 | 33108 | 35202 | 37235 |
| 66 ½ | | 16089 | 18606 | 21104 | 23565 | 25977 | 28366 | 30681 | 32991 | 35252 | 37485 | 39651 |
| 68 ½ | | 17092 | 19767 | 22422 | 25038 | 27603 | 30143 | 32604 | 35060 | 37465 | 39840 | 42143 |
| 70 ½ | | 18127 | 20964 | 23781 | 26556 | 29277 | 31973 | 34586 | 37191 | 39744 | 42266 | 44711 |
| 72 ½ | | 19191 | 22196 | 25180 | 28119 | 31002 | 33858 | 36625 | 39386 | 42091 | 44764 | 47355 |
| 74 ½ | | 20286 | 23463 | 26619 | 29727 | 32775 | 35797 | 38724 | 41644 | 44505 | 47333 | 50075 |
| 76 ½ | | 21412 | 24766 | 28098 | 31379 | 34598 | 37789 | 40880 | 43965 | 46987 | 49975 | 52871 |
| 78 ½ | | 22567 | 26103 | 29616 | 33077 | 36470 | 39836 | 43096 | 46348 | 49535 | 52688 | 55743 |
| 80 ½ | | 23754 | 27476 | 31175 | 34818 | 38391 | 41936 | 45369 | 48795 | 52152 | 55473 | 58691 |
| 82 ½ | | 24970 | 28884 | 32774 | 36605 | 40363 | 44091 | 47701 | 51305 | 54835 | 58330 | 61715 |
| 84 ½ | | 26217 | 30327 | 34413 | 38436 | 42383 | 46300 | 50092 | 53877 | 57586 | 61259 | 64815 |
| t″ | | I Axis Y - Y | | | | | | | | | | |
| 0″ | | 172.0 | 200.2 | 229.7 | 258 1 | 286.4 | 316 4 | 344.7 | 373.2 | 401.6 | 432.2 | 460.6 |
| 3/8 | | 186 6 | 217 4 | 249.3 | 280 3 | 311 1 | 343 7 | 374 4 | 405 5 | 436 4 | 469 6 | 500.5 |
| 7/16 | | 189.2 | 220 3 | 252.8 | 284 1 | 315 4 | 348 4 | 379 6 | 411.1 | 442 4 | 476 1 | 507.4 |
| 1/2 | | 191 8 | 223 3 | 256.2 | 288 0 | 319.7 | 353 2 | 384 8 | 416 7 | 448 5 | 482.7 | 514.4 |
| 5/8 | | 197.0 | 229 5 | 263.2 | 295.9 | 328.5 | 362.9 | 395.4 | 428.2 | 460.9 | 496.0 | 528.6 |
| 3/4 | | 202.4 | 235.7 | 270.4 | 304 0 | 337.5 | 372.8 | 406.2 | 440 0 | 473 5 | 509 6 | 543 1 |
| 7/8 | | 207.9 | 242.1 | 277.8 | 312 3 | 346.7 | 383 0 | 417 3 | 451.9 | 486 4 | 523 5 | 557.9 |
| 1″ | | 213.5 | 248.6 | 285.3 | 320 7 | 356.0 | 393.4 | 428 6 | 464.2 | 499.6 | 537.6 | 573.0 |
| 1 1/8 | | 219.2 | 255.3 | 292.9 | 329.3 | 365 6 | 403.9 | 440 1 | 476.7 | 513.0 | 552 1 | 588.4 |

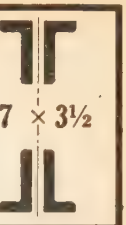



# MOMENTS OF INERTIA OF FOUR ANGLES

## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.



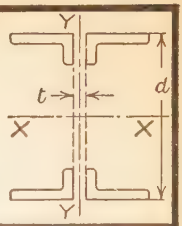

| Size | | 7″ × 3 ½″ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ |
| 4 | Area | 15 20 | 17 60 | 20 00 | 22 36 | 24 68 | 27 00 | 29 24 | 31.48 | 33.68 | 35.88 | 38 00 |
| L's | Weight | 52 0 | 60 0 | 68.0 | 76.4 | 84.0 | 92 0 | 99 6 | 107 2 | 114.8 | 122.0 | 129.2 |
| d″ | | I Axis X - X | | | | | | | | | | |
| 14 ½ | | 424 | 487 | 547 | 607 | 664 | 718 | 771 | 823 | 873 | 919 | 965 |
| 16 ½ | | 585 | 672 | 756 | 839 | 920 | 996 | 1071 | 1145 | 1216 | 1282 | 1348 |
| 18 ½ | | 775 | 892 | 1005 | 1116 | 1225 | 1328 | 1429 | 1529 | 1626 | 1717 | 1807 |
| 20 ½ | | 996 | 1147 | 1294 | 1438 | 1579 | 1714 | 1846 | 1977 | 2104 | 2223 | 2342 |
| 22 ½ | | 1248 | 1438 | 1622 | 1805 | 1983 | 2154 | 2322 | 2487 | 2648 | 2802 | 2953 |
| 24 ½ | | 1529 | 1763 | 1991 | 2217 | 2436 | 2648 | 2856 | 3061 | 3261 | 3452 | 3640 |
| 26 ½ | | 1842 | 2124 | 2400 | 2673 | 2939 | 3196 | 3448 | 3698 | 3940 | 4174 | 4403 |
| 28 ½ | | 2184 | 2520 | 2849 | 3174 | 3490 | 3798 | 4099 | 4397 | 4687 | 4967 | 5242 |
| 30 ½ | | 2557 | 2951 | 3338 | 3719 | 4092 | 4454 | 4808 | 5160 | 5502 | 5833 | 6157 |
| 32 ½ | | 2961 | 3418 | 3866 | 4309 | 4742 | 5165 | 5576 | 5985 | 6384 | 6770 | 7148 |
| 34 ½ | | 3394 | 3919 | 4435 | 4944 | 5442 | 5929 | 6402 | 6873 | 7333 | 7779 | 8215 |
| 36 ½ | | 3859 | 4456 | 5044 | 5624 | 6191 | 6747 | 7287 | 7825 | 8349 | 8860 | 9358 |
| 38 ½ | | 4353 | 5028 | 5693 | 6349 | 6990 | 7619 | 8230 | 8839 | 9433 | 10012 | 10577 |
| 40 ½ | | 4878 | 5635 | 6382 | 7118 | 7838 | 8545 | 9232 | 9916 | 10584 | 11236 | 11872 |
| 42 ½ | | 5434 | 6278 | 7110 | 7932 | 8735 | 9525 | 10292 | 11056 | 11803 | 12532 | 13243 |
| 44 ½ | | 6019 | 6955 | 7879 | 8790 | 9682 | 10559 | 11411 | 12260 | 13089 | 13900 | 14690 |
| 46 ½ | | 6636 | 7668 | 8688 | 9694 | 10678 | 11647 | 12588 | 13526 | 14442 | 15339 | 16213 |
| 48 ½ | | 7282 | 8416 | 9537 | 10642 | 11724 | 12789 | 13824 | 14855 | 15862 | 16851 | 17812 |
| 50 ½ | | 7959 | 9199 | 10426 | 11635 | 12818 | 13985 | 15118 | 16247 | 17350 | 18434 | 19487 |
| 52 ½ | | 8667 | 10018 | 11354 | 12672 | 13963 | 15236 | 16471 | 17702 | 18906 | 20089 | 21238 |
| 54 ½ | | 9404 | 10871 | 12323 | 13754 | 15156 | 16540 | 17882 | 19220 | 20529 | 21815 | 23066 |
| 56 ½ | | 10173 | 11760 | 13332 | 14881 | 16399 | 17898 | 19352 | 20801 | 22219 | 23613 | 24969 |
| 58 ½ | | 10971 | 12684 | 14381 | 16053 | 17691 | 19310 | 20880 | 22445 | 23976 | 25483 | 26948 |
| 60 ½ | | 11800 | 13643 | 15470 | 17269 | 19033 | 20776 | 22466 | 24151 | 25801 | 27425 | 29003 |
| 62 ½ | | 12660 | 14638 | 16598 | 18530 | 20424 | 22296 | 24111 | 25921 | 27693 | 29439 | 31134 |
| 64 ½ | | 13550 | 15667 | 17767 | 19836 | 21864 | 23870 | 25815 | 27754 | 29652 | 31524 | 33341 |
| 66 ½ | | 14470 | 16732 | 18976 | 21187 | 23354 | 25498 | 27577 | 29650 | 31679 | 33681 | 35624 |
| 68 ½ | | 15420 | 17832 | 20225 | 22582 | 24893 | 27180 | 29397 | 31608 | 33773 | 35910 | 37983 |
| 70 ½ | | 16401 | 18967 | 21514 | 24022 | 26481 | 28916 | 31276 | 33630 | 35935 | 38211 | 40418 |
| 72 ½ | | 17413 | 20138 | 22842 | 25507 | 28119 | 30707 | 33214 | 35715 | 38164 | 40583 | 42929 |
| 74 ½ | | 18455 | 21343 | 24211 | 27036 | 29806 | 32551 | 35210 | 37862 | 40460 | 43027 | 45516 |
| 76 ½ | | 19527 | 22584 | 25620 | 28610 | 31543 | 34419 | 37264 | 40073 | 42824 | 45543 | 48179 |
| 78 ½ | | 20629 | 23860 | 27069 | 30229 | 33328 | 36401 | 39377 | 42346 | 45255 | 48131 | 50918 |
| 80 ½ | | 21762 | 25171 | 28558 | 31893 | 35164 | 38407 | 41548 | 44683 | 47753 | 50790 | 53733 |
| 82 ½ | | 22926 | 26518 | 30088 | 33601 | 37048 | 40467 | 43778 | 47082 | 50319 | 53521 | 56624 |
| 84 ½ | | 24120 | 27899 | 31656 | 35354 | 38982 | 42581 | 46066 | 49544 | 52952 | 56324 | 59591 |
| 90 ½ | | 27883 | 32255 | 36602 | 40881 | 45080 | 49247 | 53283 | 57309 | 61256 | 65164 | 68948 |
| 96 ½ | | 31921 | 36928 | 41908 | 46811 | 51622 | 56400 | 61024 | 65641 | 70165 | 74649 | 78989 |
| 102 ½ | | 36232 | 41918 | 47574 | 53144 | 58609 | 64038 | 69293 | 74539 | 79681 | 84780 | 89714 |
| 108 ½ | | 40817 | 47224 | 53601 | 59879 | 66039 | 72162 | 78088 | 84004 | 89804 | 95557 | 101124 |
| 114 ½ | | 45675 | 52847 | 59987 | 67016 | 73914 | 80773 | 87409 | 94035 | 100532 | 106980 | 113217 |
| 120 ½ | | 50807 | 58787 | 66734 | 74556 | 82233 | 89869 | 97256 | 104633 | 111867 | 119048 | 125994 |
| t″ | | I Axis Y - Y | | | | | | | | | | |
| 0″ | | 22.0 | 25.7 | 29.8 | 33 8 | 37.7 | 42.3 | 46.5 | 50.8 | 55.2 | 60.4 | 65.1 |
| 3/8 | | 26.7 | 31.3 | 36.4 | 41.2 | 46.2 | 51 8 | 57.0 | 62.4 | 67.9 | 74.3 | 80 2 |
| 7/16 | | 27.6 | 32.3 | 37.6 | 42 6 | 47.7 | 53.6 | 59.0 | 64.5 | 70.2 | 76 9 | 82 9 |
| 1/2 | | 28.5 | 33.4 | 38.9 | 44.1 | 49.4 | 55 4 | 61.0 | 66.8 | 72.6 | 79.5 | 85 8 |
| 5/8 | | 30.4 | 35.7 | 41.5 | 47.1 | 52.8 | 59.2 | 65.2 | 71.4 | 77.7 | 85.0 | 91.7 |
| 3/4 | | 32.4 | 38.1 | 44.3 | 50 3 | 56.4 | 63.3 | 69.6 | 76.2 | 82.9 | 90 8 | 97.8 |
| 7/8 | | 34.6 | 40.6 | 47.3 | 53.7 | 60.1 | 67.5 | 74.3 | 81.3 | 88.5 | 96 8 | 104.3 |
| 1″ | | 36.9 | 43.3 | 50.4 | 57 2 | 64.1 | 72 0 | 79.2 | 86.7 | 94.3 | 103.1 | 111.1 |
| 1 1/8 | | 39.3 | 46.1 | 53.7 | 60.9 | 68.3 | 76 6 | 84.3 | 92.3 | 100.3 | 109 7 | 118 2 |

# MOMENTS OF INERTIA OF FOUR ANGLES

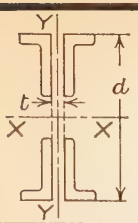
## UNEQUAL LEG ANGLES—SHORT LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.




| Size | | 8″ × 6″ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ |
| 4 | Area | 23.72 | 27.00 | 30.24 | 33.44 | 36.60 | 39.76 | 42.88 | 45.92 | 49.00 | 52.00 |
| L's | Weight | 80.8 | 92.0 | 102.8 | 114.0 | 124.8 | 135.2 | 146.0 | 156.4 | 166.8 | 176.8 |
| d″ | | I Axis X - X | | | | | | | | | |
| 12 1/2 | | 624 | 704 | 778 | 853 | 926 | 997 | 1062 | 1128 | 1193 | 1255 |
| 14 1/2 | | 875 | 989 | 1096 | 1203 | 1308 | 1410 | 1505 | 1600 | 1695 | 1786 |
| 16 1/2 | | 1174 | 1328 | 1474 | 1620 | 1762 | 1902 | 2033 | 2164 | 2295 | 2420 |
| 18 1/2 | | 1520 | 1721 | 1912 | 2103 | 2290 | 2474 | 2647 | 2820 | 2993 | 3159 |
| 20 1/2 | | 1914 | 2168 | 2411 | 2654 | 2891 | 3125 | 3347 | 3568 | 3788 | 4001 |
| 22 1/2 | | 2355 | 2669 | 2971 | 3271 | 3565 | 3856 | 4133 | 4407 | 4682 | 4947 |
| 24 1/2 | | 2844 | 3224 | 3591 | 3955 | 4312 | 4667 | 5004 | 5338 | 5674 | 5998 |
| 26 1/2 | | 3380 | 3833 | 4271 | 4706 | 5133 | 5556 | 5961 | 6361 | 6764 | 7152 |
| 28 1/2 | | 3963 | 4497 | 5012 | 5524 | 6027 | 6526 | 7004 | 7476 | 7951 | 8411 |
| 30 1/2 | | 4594 | 5214 | 5813 | 6409 | 6994 | 7575 | 8133 | 8683 | 9237 | 9773 |
| 32 1/2 | | 5273 | 5985 | 6675 | 7361 | 8034 | 8703 | 9347 | 9982 | 10621 | 11239 |
| 34 1/2 | | 5999 | 6810 | 7598 | 8379 | 9147 | 9911 | 10647 | 11372 | 12103 | 12810 |
| 36 1/2 | | 6772 | 7689 | 8580 | 9465 | 10334 | 11198 | 12033 | 12854 | 13682 | 14484 |
| 38 1/2 | | 7593 | 8622 | 9624 | 10617 | 11594 | 12565 | 13505 | 14428 | 15360 | 16263 |
| 40 1/2 | | 8461 | 9609 | 10727 | 11836 | 12927 | 14012 | 15062 | 16094 | 17136 | 18145 |
| 42 1/2 | | 9376 | 10650 | 11892 | 13123 | 14333 | 15538 | 16705 | 17852 | 19010 | 20131 |
| 44 1/2 | | 10339 | 11746 | 13116 | 14476 | 15812 | 17143 | 18434 | 19702 | 20981 | 22222 |
| 46 1/2 | | 11350 | 12895 | 14402 | 15895 | 17365 | 18828 | 20249 | 21643 | 23051 | 24416 |
| 48 1/2 | | 12408 | 14098 | 15747 | 17382 | 18990 | 20593 | 22149 | 23677 | 25219 | 26715 |
| 50 1/2 | | 13513 | 15355 | 17153 | 18936 | 20689 | 22437 | 24135 | 25082 | 27485 | 29117 |
| 52 1/2 | | 14666 | 16666 | 18620 | 20556 | 22462 | 24360 | 26207 | 28019 | 29848 | 31623 |
| 54 1/2 | | 15866 | 18031 | 20147 | 22244 | 24307 | 26364 | 28365 | 30328 | 32310 | 34234 |
| 56 1/2 | | 17114 | 19450 | 21735 | 23998 | 26226 | 28446 | 30608 | 32728 | 34870 | 36948 |
| 58 1/2 | | 18409 | 20923 | 23383 | 25819 | 28217 | 30608 | 32938 | 35221 | 37528 | 39767 |
| 60 1/2 | | 19751 | 22450 | 25091 | 27707 | 30282 | 32850 | 35353 | 37805 | 40284 | 42689 |
| 62 1/2 | | 21141 | 24032 | 26860 | 29662 | 32420 | 35171 | 37853 | 40482 | 43137 | 45715 |
| 64 1/2 | | 22579 | 25667 | 28690 | 31684 | 34632 | 37572 | 40440 | 43250 | 46089 | 48846 |
| 66 1/2 | | 24064 | 27356 | 30580 | 33772 | 36916 | 40052 | 43112 | 46110 | 49139 | 52080 |
| 68 1/2 | | 25596 | 29099 | 32530 | 35928 | 39274 | 42612 | 45870 | 49061 | 52287 | 55419 |
| 70 1/2 | | 27176 | 30896 | 34541 | 38150 | 41705 | 45251 | 48714 | 52105 | 55532 | 58861 |
| 72 1/2 | | 28803 | 32747 | 36613 | 40440 | 44209 | 47970 | 51644 | 55240 | 58876 | 62407 |
| 74 1/2 | | 30478 | 34652 | 38745 | 42796 | 46787 | 50768 | 54659 | 58468 | 62318 | 66058 |
| 76 1/2 | | 32200 | 36611 | 40937 | 45219 | 49437 | 53646 | 57760 | 61787 | 65858 | 69812 |
| 78 1/2 | | 33969 | 38625 | 43190 | 47709 | 52161 | 56603 | 60947 | 65198 | 69495 | 73671 |
| 80 1/2 | | 35786 | 40692 | 45503 | 50266 | 54958 | 59640 | 64220 | 68700 | 73231 | 77633 |
| 82 1/2 | | 37651 | 42813 | 47877 | 52889 | 57828 | 62757 | 67578 | 72295 | 77065 | 81699 |
| 84 1/2 | | 39562 | 44988 | 50312 | 55800 | 60771 | 65953 | 71022 | 75981 | 80997 | 85870 |
| 90 1/2 | | 45583 | 51837 | 57977 | 64053 | 70041 | 76017 | 81869 | 87592 | 93380 | 99005 |
| 96 1/2 | | 52030 | 59173 | 66188 | 73128 | 79969 | 86798 | 93488 | 100029 | 106645 | 113076 |
| 102 1/2 | | 58904 | 66994 | 74942 | 82805 | 90556 | 98294 | 105878 | 113292 | 120792 | 128083 |
| 108 1/2 | | 66205 | 75301 | 84241 | 93084 | 101802 | 110506 | 119041 | 127382 | 135822 | 144027 |
| 114 1/2 | | 73933 | 84095 | 94084 | 103964 | 113706 | 123434 | 132975 | 142299 | 151733 | 160906 |
| t″ | | I Axis Y - Y | | | | | | | | | |
| 0″ | | 299.3 | 342.0 | 386.0 | 428.8 | 471.4 | 514.3 | 559.3 | 602.1 | 645.3 | 688.3 |
| 3/8 | | 321.9 | 367.9 | 415.5 | 461.5 | 507.6 | 553.8 | 602.5 | 648.6 | 695.3 | 741.8 |
| 7/16 | | 325.8 | 372.4 | 420.6 | 467.2 | 513.8 | 560.7 | 610.0 | 656.7 | 704.0 | 751.1 |
| 1/2 | | 329.8 | 377.0 | 425.7 | 473.0 | 520.2 | 567.6 | 617.5 | 664.9 | 712.8 | 760.5 |
| 5/8 | | 337.9 | 386.3 | 436.3 | 484.7 | 533.1 | 581.8 | 632.9 | 681.5 | 730.6 | 779.5 |
| 3/4 | | 346.2 | 395.8 | 447.0 | 496.7 | 546.3 | 596.2 | 648.6 | 698.4 | 748.8 | 799.0 |
| 7/8 | | 354.7 | 405.5 | 458.0 | 508.9 | 559.8 | 611.0 | 664.7 | 715.8 | 767.4 | 818.8 |
| 1″ | | 363.3 | 415.4 | 469.2 | 521.4 | 573.5 | 626.0 | 681.1 | 733.4 | 786.4 | 839.1 |
| 1 1/8 | | 372.1 | 425.5 | 480.7 | 534.2 | 587.5 | 641.4 | 697.8 | 751.5 | 805.8 | 859.8 |
| 1 1/4 | | 381.2 | 435.9 | 492.4 | 547.2 | 601.9 | 657.1 | 714.9 | 769.9 | 825.5 | 880.9 |
| 1 1/2 | | 399.8 | 457.2 | 516.5 | 574.0 | 631.4 | 689.3 | 750.0 | 807.7 | 866.2 | 924.2 |




# MOMENTS OF INERTIA OF FOUR ANGLES

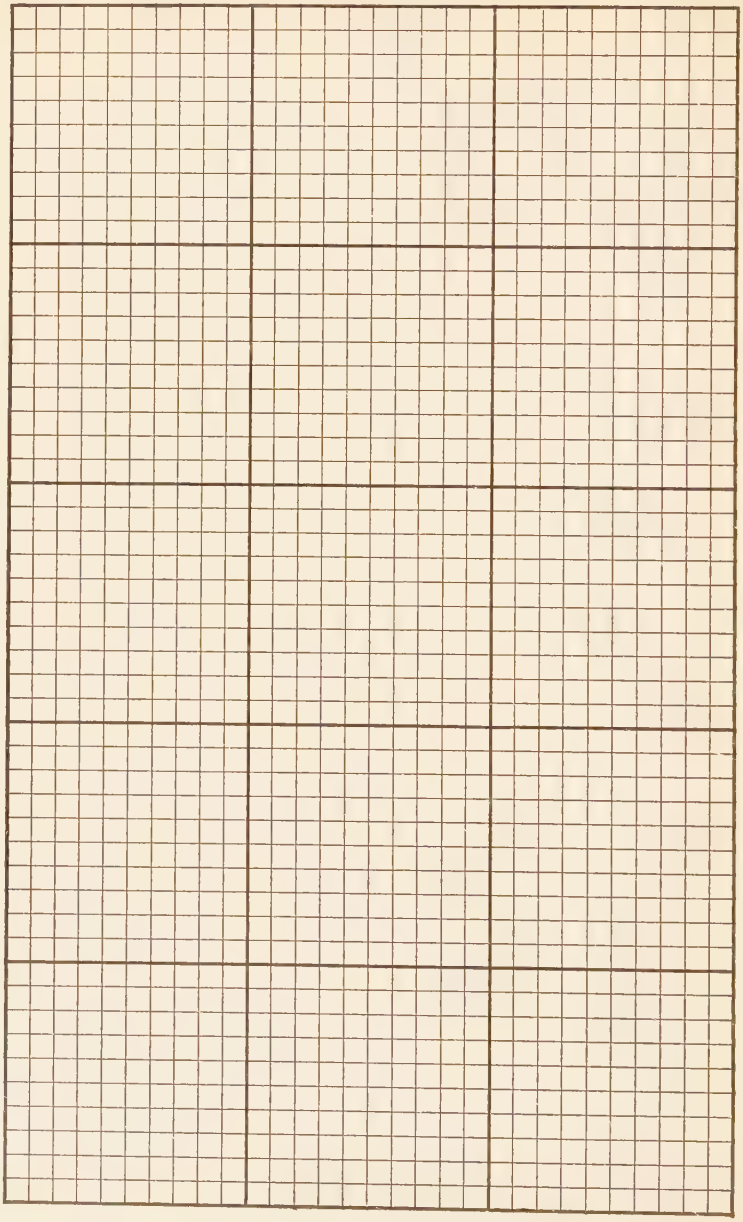
## UNEQUAL LEG ANGLES—LONG LEGS BACK TO BACK

AXIS X - X for distances measured from back to back.
AXIS Y - Y for various thicknesses of web plates.

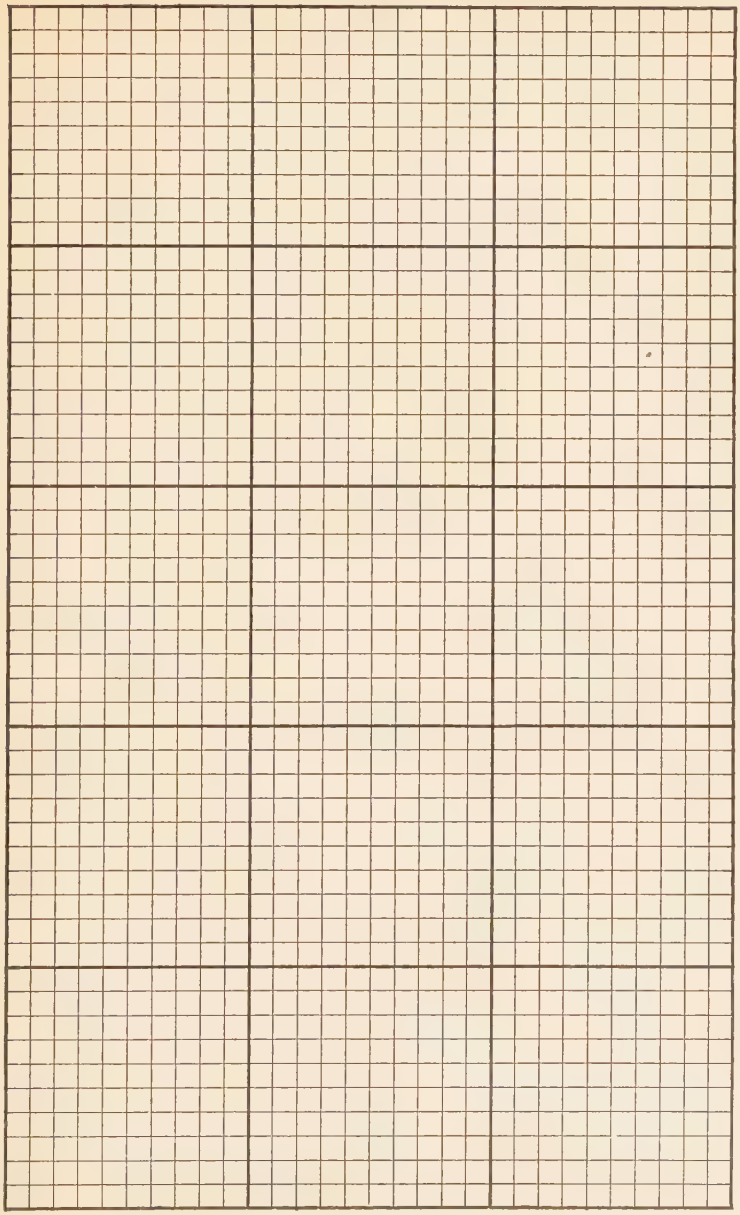
To find the approximate Moment of Inertia of the Net Area multiply the Tabular Value by the Net Area and divide by the Gross Area.

| Size | | 8″ × 6″ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness | | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ |
| 4 L's | Area | 23.72 | 27.00 | 30 24 | 33 44 | 36.60 | 39.76 | 42 88 | 45.92 | 49.00 | 52.00 |
| | Weight | 80.8 | 92.0 | 102.8 | 114.0 | 124.8 | 135.2 | 146.0 | 156.4 | 166 8 | 176.8 |
| d″ | | I Axis X - X | | | | | | | | | |
| 16 1/2 | | 955 | 1079 | 1197 | 1314 | 1429 | 1541 | 1645 | 1750 | 1854 | 1954 |
| 18 1/2 | | 1254 | 1418 | 1575 | 1731 | 1883 | 2033 | 2174 | 2314 | 2454 | 2588 |
| 20 1/2 | | 1600 | 1812 | 2013 | 2215 | 2411 | 2605 | 2788 | 2970 | 3152 | 3327 |
| 22 1/2 | | 1994 | 2259 | 2512 | 2765 | 3012 | 3256 | 3488 | 3717 | 3947 | 4169 |
| 24 1/2 | | 2435 | 2760 | 3072 | 3382 | 3686 | 3987 | 4273 | 4557 | 4841 | 5115 |
| 26 1/2 | | 2924 | 3315 | 3692 | 4066 | 4433 | 4797 | 5144 | 5488 | 5833 | 6166 |
| 28 1/2 | | 3460 | 3924 | 4372 | 4818 | 5254 | 5687 | 6101 | 6511 | 6923 | 7320 |
| 30 1/2 | | 4043 | 4587 | 5113 | 5635 | 6148 | 6656 | 7144 | 7626 | 8110 | 8579 |
| 32 1/2 | | 4674 | 5304 | 5914 | 6520 | 7115 | 7705 | 8273 | 8833 | 9396 | 9941 |
| 34 1/2 | | 5353 | 6075 | 6776 | 7472 | 8155 | 8834 | 9487 | 10131 | 10780 | 11407 |
| 36 1/2 | | 6078 | 6900 | 7698 | 8491 | 9268 | 10042 | 10787 | 11522 | 12262 | 12978 |
| 38 1/2 | | 6852 | 7780 | 8681 | 9576 | 10455 | 11329 | 12173 | 13004 | 13841 | 14652 |
| 40 1/2 | | 7672 | 8713 | 9725 | 10728 | 11715 | 12696 | 13645 | 14578 | 15519 | 16431 |
| 42 1/2 | | 8540 | 9700 | 10828 | 11948 | 13048 | 14143 | 15202 | 16244 | 17295 | 18313 |
| 44 1/2 | | 9456 | 10741 | 11993 | 13234 | 14454 | 15668 | 16845 | 18002 | 19169 | 20299 |
| 46 1/2 | | 10419 | 11836 | 13217 | 14587 | 15933 | 17274 | 18574 | 19852 | 21140 | 22390 |
| 48 1/2 | | 11430 | 12985 | 14502 | 16007 | 17486 | 18959 | 20389 | 21793 | 23210 | 24584 |
| 50 1/2 | | 12487 | 14188 | 15848 | 17493 | 19111 | 20734 | 22290 | 23827 | 25378 | 26883 |
| 52 1/2 | | 13593 | 15445 | 17254 | 19047 | 20810 | 22568 | 24277 | 25952 | 27644 | 29285 |
| 54 1/2 | | 14746 | 16757 | 18721 | 20667 | 22583 | 24491 | 26349 | 28169 | 30007 | 31791 |
| 56 1/2 | | 15946 | 18122 | 20248 | 22355 | 24428 | 26494 | 28506 | 30478 | 32469 | 34402 |
| 58 1/2 | | 17194 | 19541 | 21836 | 24109 | 26347 | 28577 | 30750 | 32878 | 35029 | 37116 |
| 60 1/2 | | 18489 | 21014 | 23484 | 25930 | 28338 | 30739 | 33079 | 35371 | 37687 | 39935 |
| 62 1/2 | | 19831 | 22541 | 25192 | 27818 | 30403 | 32981 | 35494 | 37955 | 40442 | 42857 |
| 64 1/2 | | 21221 | 24122 | 26961 | 29773 | 32541 | 35302 | 37995 | 40631 | 43296 | 45883 |
| 66 1/2 | | 22659 | 25757 | 28791 | 31795 | 34753 | 37703 | 40581 | 43400 | 46248 | 49014 |
| 68 1/2 | | 24143 | 27446 | 30681 | 33884 | 37037 | 40183 | 43254 | 46259 | 49298 | 52248 |
| 70 1/2 | | 25676 | 29190 | 32631 | 36039 | 39395 | 42743 | 46012 | 49211 | 52446 | 55587 |
| 72 1/2 | | 27256 | 30987 | 34642 | 38261 | 41826 | 45382 | 48856 | 52255 | 55691 | 59029 |
| 74 1/2 | | 28883 | 32838 | 36714 | 40551 | 44330 | 48101 | 51785 | 55390 | 59035 | 62575 |
| 76 1/2 | | 30557 | 34743 | 38846 | 42907 | 46908 | 50899 | 54800 | 58617 | 62477 | 66226 |
| 78 1/2 | | 32279 | 36702 | 41038 | 45330 | 49558 | 53777 | 57901 | 61937 | 66017 | 69980 |
| 80 1/2 | | 34049 | 38715 | 43291 | 47820 | 52282 | 56734 | 61088 | 65347 | 69654 | 73839 |
| 82 1/2 | | 35866 | 40782 | 45604 | 50377 | 55079 | 59771 | 64361 | 68850 | 73390 | 77801 |
| 84 1/2 | | 37730 | 42903 | 47978 | 53000 | 57949 | 62887 | 67719 | 72445 | 77224 | 81867 |
| 90 1/2 | | 43608 | 49591 | 55463 | 61273 | 66999 | 72714 | 78309 | 83780 | 89313 | 94691 |
| 96 1/2 | | 49913 | 56764 | 63491 | 70147 | 76707 | 83256 | 89670 | 95941 | 102284 | 108450 |
| 102 1/2 | | 56645 | 64423 | 72064 | 79623 | 87075 | 94513 | 101804 | 108929 | 116138 | 123145 |
| 108 1/2 | | 63803 | 72569 | 81182 | 89702 | 98101 | 106487 | 114709 | 122744 | 130873 | 138776 |
| 114 1/2 | | 71389 | 81200 | 90843 | 100382 | 109786 | 119176 | 128386 | 137385 | 146490 | 155343 |
| 120 1/2 | | 79402 | 90318 | 101049 | 111664 | 122129 | 132580 | 142835 | 152853 | 162990 | 172847 |
| t″ | | I Axis Y - Y | | | | | | | | | |
| 0″ | | 126.9 | 145.1 | 164.2 | 182.6 | 201.0 | 219.6 | 239.7 | 258 5 | 277.6 | 296.7 |
| 3/8 | | 140.6 | 160.9 | 182.3 | 202 8 | 223.5 | 244.3 | 266 8 | 287 8 | 309 3 | 330.7 |
| 7/16 | | 143.0 | 163.7 | 185.5 | 206.4 | 227.4 | 248.7 | 271.7 | 293.0 | 314 9 | 336.7 |
| 1/2 | | 145.5 | 166.6 | 188.8 | 210.1 | 231.5 | 253 2 | 276.5 | 298 3 | 320 6 | 342.8 |
| 5/8 | | 150.7 | 172.5 | 195.5 | 217 6 | 239.8 | 262 3 | 286.5 | 309 1 | 332 3 | 355.4 |
| 3/4 | | 156.0 | 178.6 | 202.5 | 225 4 | 248.5 | 271.8 | 296 8 | 320 4 | 344 4 | 368.4 |
| 7/8 | | 161.5 | 184.9 | 209.7 | 233 5 | 257.4 | 281.6 | 307.5 | 331 9 | 356 9 | 381.7 |
| 1″ | | 167.2 | 191.5 | 217.1 | 241 8 | 266.6 | 291.6 | 318 6 | 343 9 | 369 7 | 395.5 |
| 1 1/8 | | 173.0 | 198.3 | 224.8 | 250 4 | 276.0 | 302.1 | 330 0 | 356 1 | 382 9 | 409.6 |
| 1 1/4 | | 179.1 | 205.2 | 232.7 | 259 2 | 285.8 | 312.7 | 341.7 | 368 8 | 396 6 | 424.3 |
| 1 1/2 | | 191.8 | 219.8 | 249.3 | 277.6 | 306.2 | 335.0 | 366.1 | 395.2 | 425 0 | 454.6 |

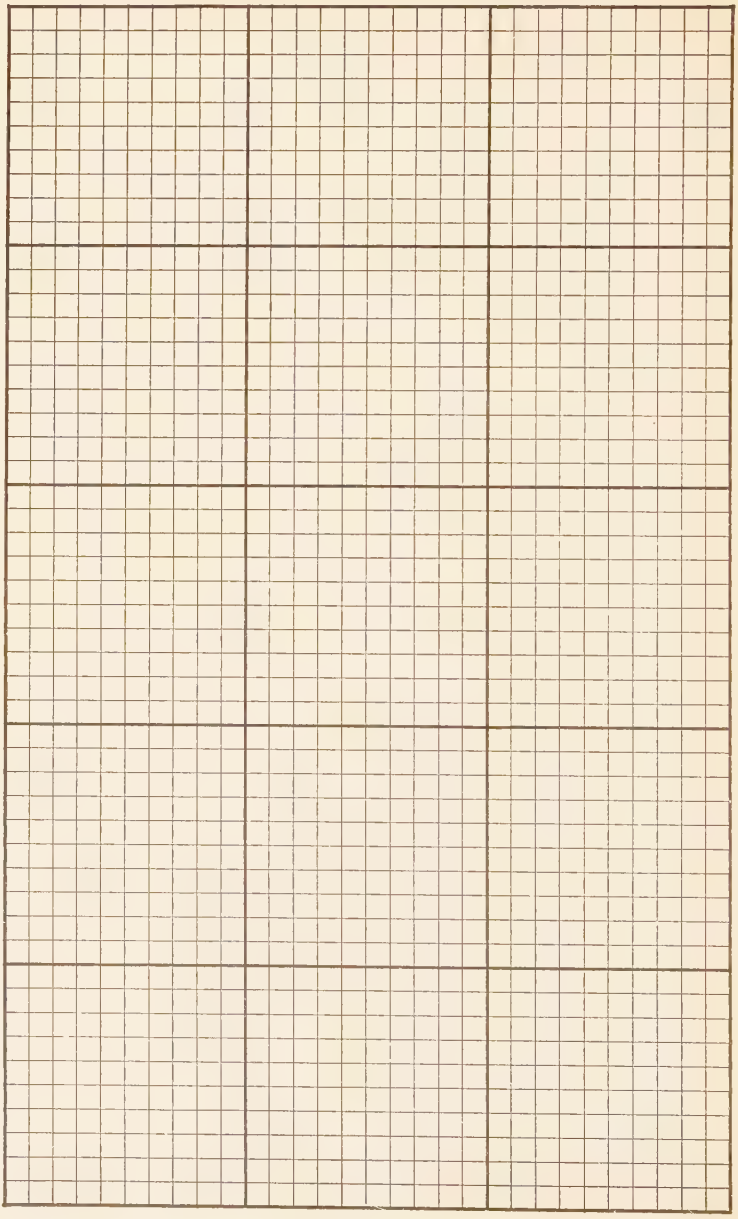
## NOTES and DIAGRAMS



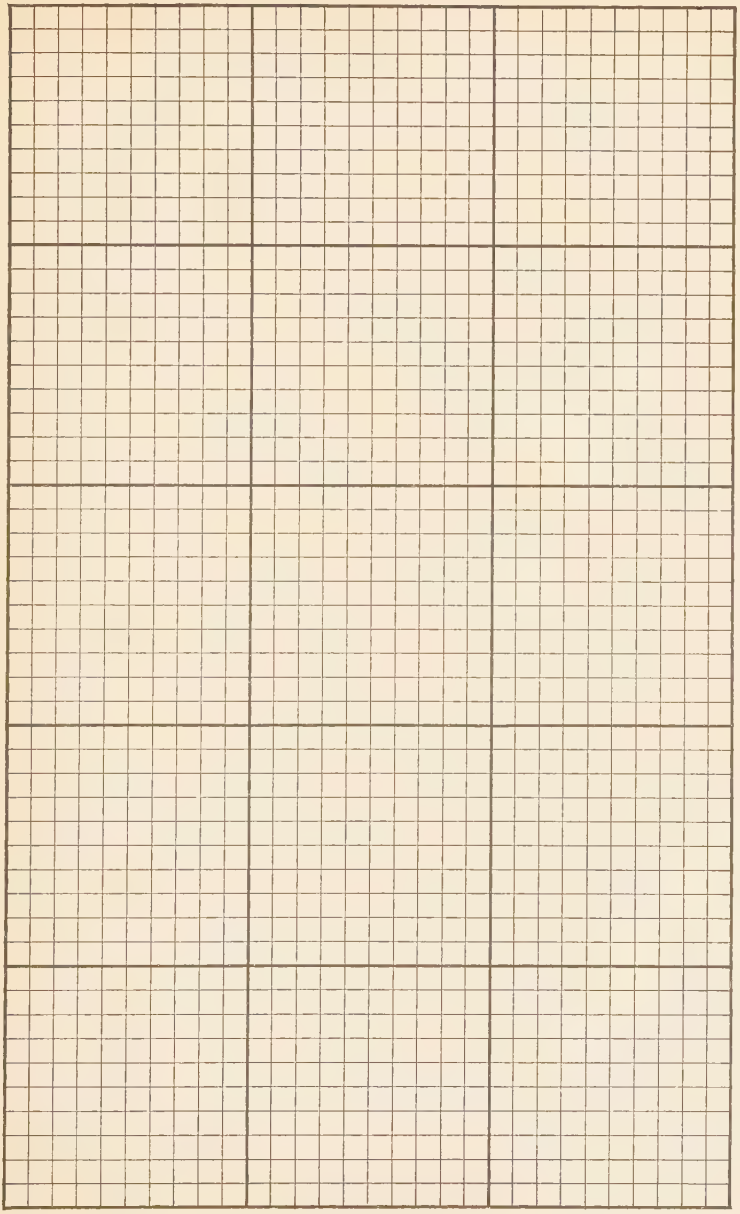
## NOTES and DIAGRAMS



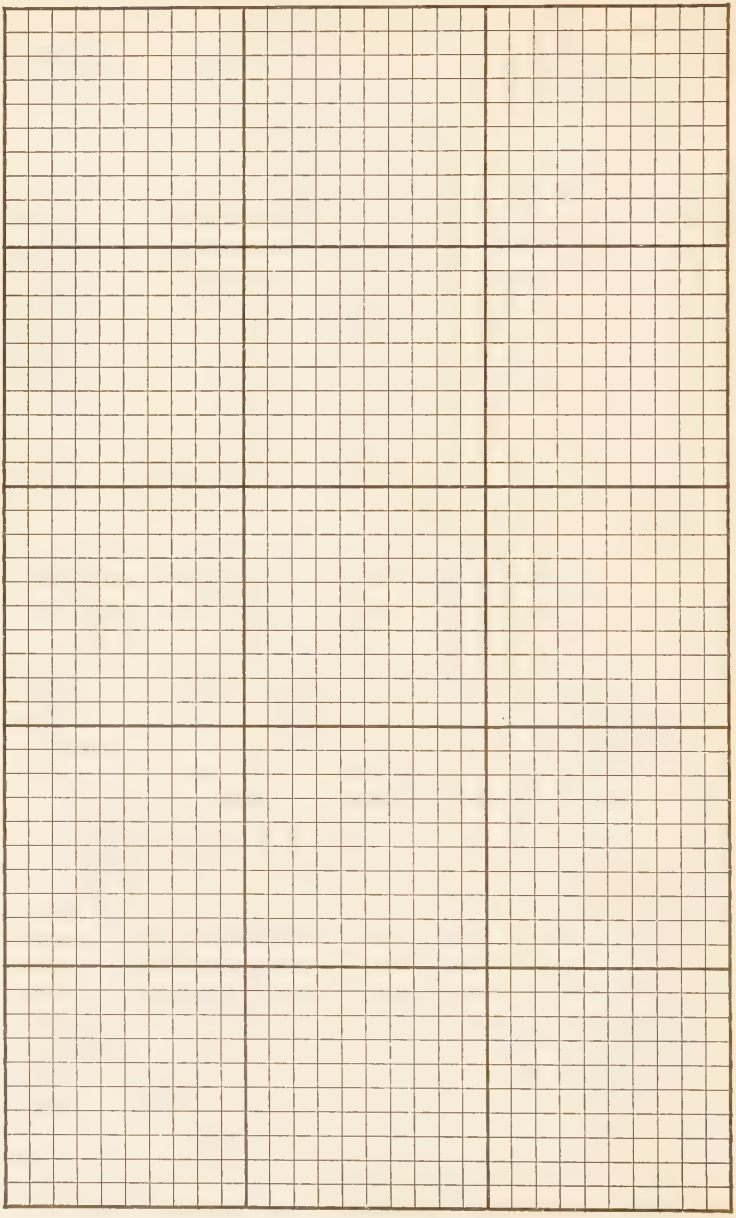
## NOTES and DIAGRAMS



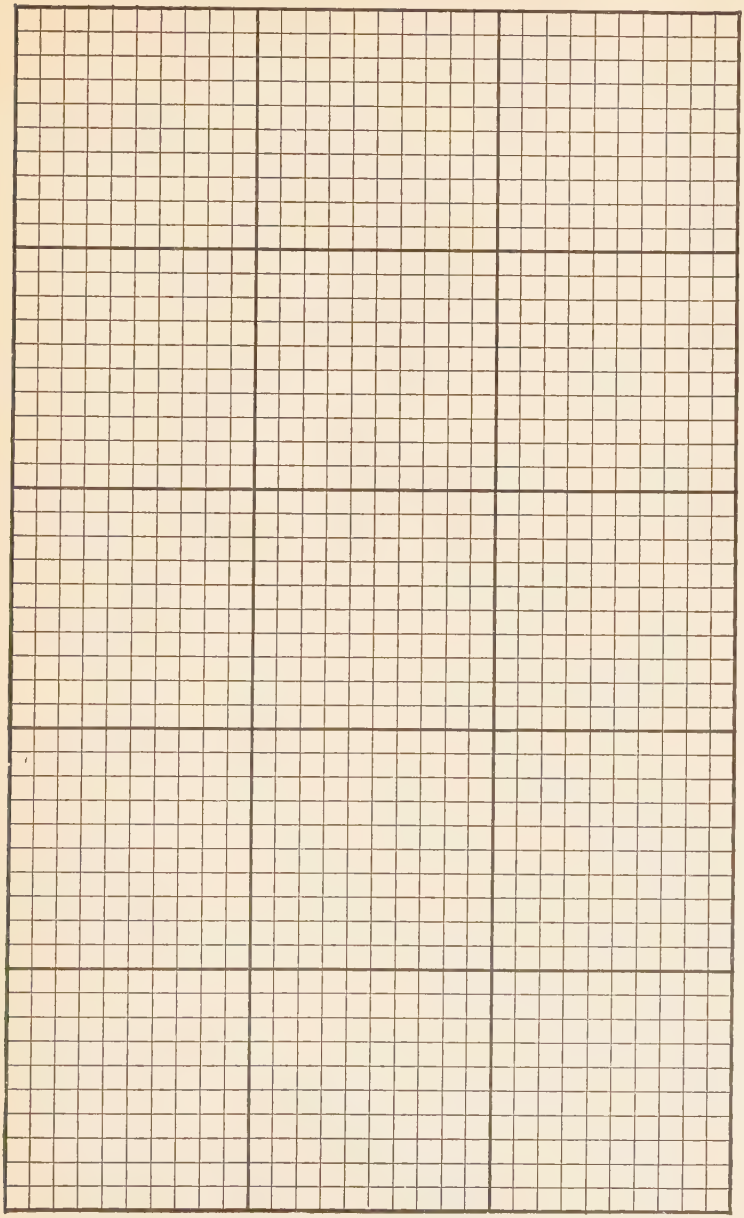
## NOTES and DIAGRAMS



## NOTES and DIAGRAMS

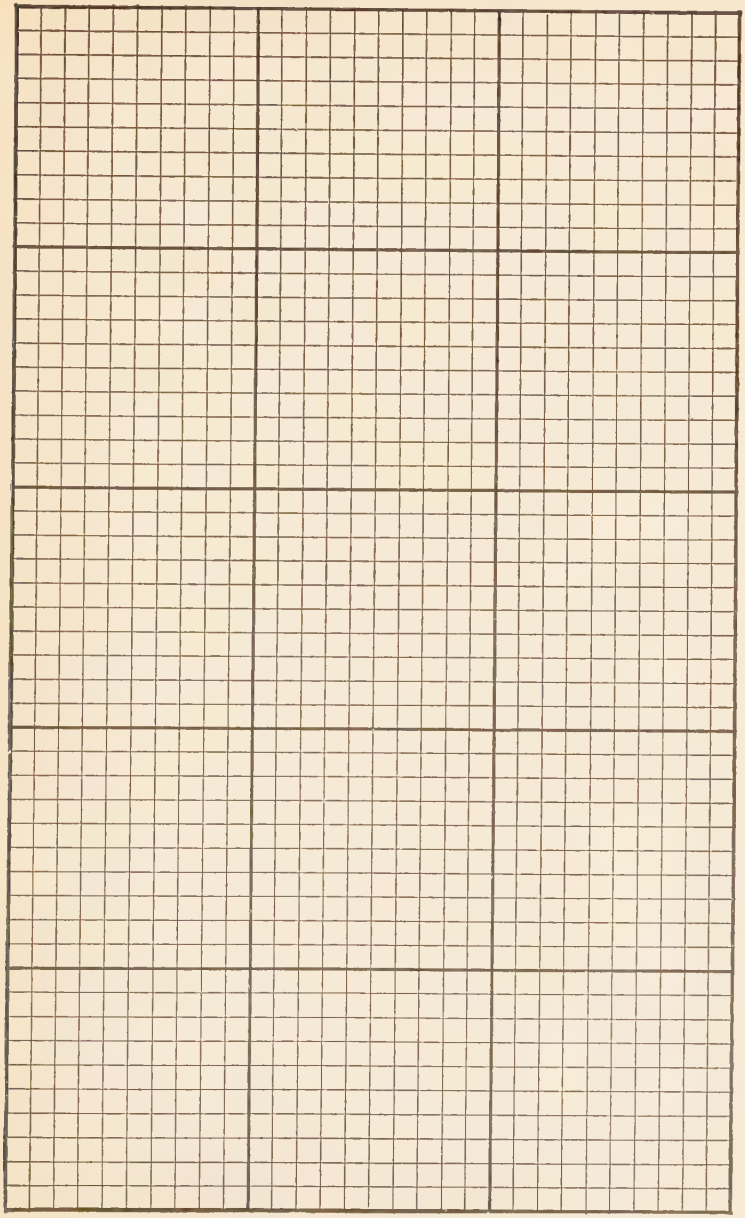


## NOTES and DIAGRAMS

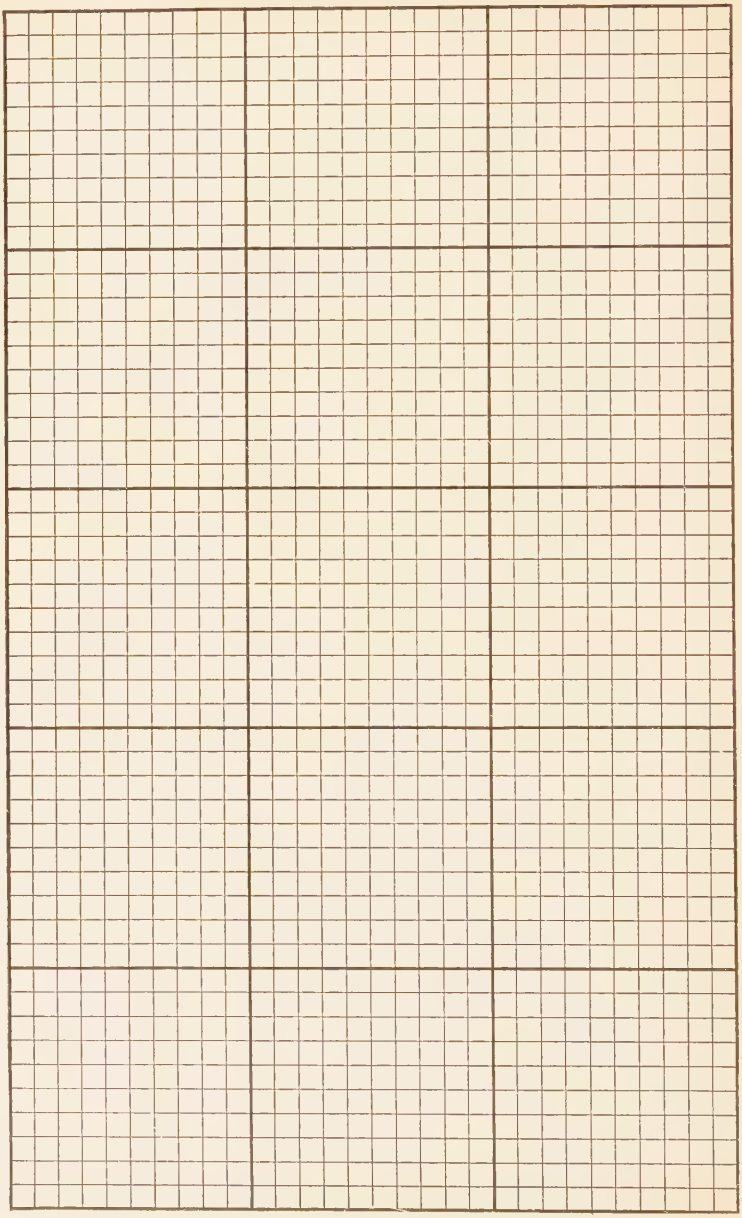


## NOTES and DIAGRAMS

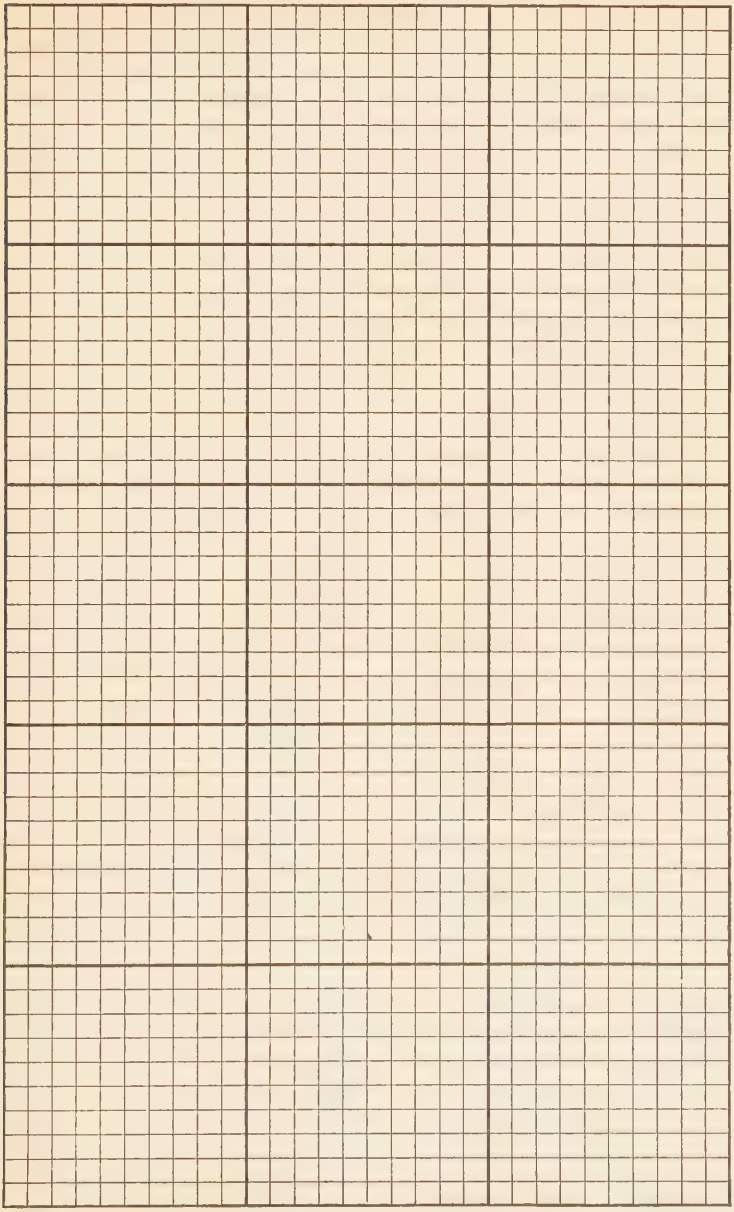
## NOTES and DIAGRAMS



## NOTES and DIAGRAMS



## NOTES and DIAGRAMS



# AREAS OF RECTANGULAR SECTIONS

## SQUARE INCHES

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 1/4 | .016 | .031 | .047 | .063 | .078 | .094 | .109 | .125 | .141 | .156 | .172 | .188 | .203 | .22 | .23 | .25 |
| 1/2 | .031 | .063 | .094 | .125 | .156 | .188 | .219 | .250 | .281 | .313 | .344 | .375 | .406 | .44 | .47 | .50 |
| 3/4 | .047 | .094 | .141 | .188 | .234 | .281 | .328 | .375 | .422 | .469 | .516 | .563 | .609 | .66 | .70 | .75 |
| 1 | .063 | .125 | .188 | .250 | .313 | .375 | .438 | .500 | .563 | .625 | .688 | .750 | .813 | .88 | .94 | 1.00 |
| 1 1/4 | .078 | .156 | .234 | .313 | .391 | .469 | .547 | .625 | .703 | .781 | .859 | .938 | 1.016 | 1.09 | 1.17 | 1.25 |
| 1 1/2 | .094 | .188 | .281 | .375 | .469 | .563 | .656 | .750 | .844 | .938 | 1.031 | 1.125 | 1.219 | 1.31 | 1.41 | 1.50 |
| 1 3/4 | .109 | .219 | .328 | .438 | .547 | .656 | .766 | .875 | .984 | 1.094 | 1.203 | 1 313 | 1.422 | 1.53 | 1.64 | 1.75 |
| 2 | .125 | .250 | .375 | .500 | .625 | .750 | .875 | 1.000 | 1.125 | 1.250 | 1.375 | 1.500 | 1.625 | 1.75 | 1.88 | 2.00 |
| 2 1/4 | .141 | .281 | .422 | .563 | .703 | .844 | .984 | 1.125 | 1.266 | 1.406 | 1.547 | 1.688 | 1.828 | 1.97 | 2.11 | 2.25 |
| 2 1/2 | .156 | .313 | .469 | .625 | 781 | .938 | 1.094 | 1.250 | 1.406 | 1.563 | 1.719 | 1.875 | 2.031 | 2.19 | 2 34 | 2.50 |
| 2 3/4 | .172 | .344 | .516 | .688 | .859 | 1.031 | 1.203 | 1.375 | 1.547 | 1.719 | 1.891 | 2 063 | 2.234 | 2.41 | 2.58 | 2.75 |
| 3 | .188 | .375 | .563 | .750 | .938 | 1.125 | 1.313 | 1.500 | 1.688 | 1.875 | 2.063 | 2 250 | 2.438 | 2.63 | 2.81 | 3.00 |
| 3 1/4 | .203 | .406 | .609 | .813 | 1 016 | 1.219 | 1 422 | 1.625 | 1.828 | 2 031 | 2 234 | 2 438 | 2.641 | 2 84 | 3.05 | 3 25 |
| 3 1/2 | .219 | .438 | .656 | .875 | 1.094 | 1.313 | 1.531 | 1 750 | 1.969 | 2 188 | 2.406 | 2 625 | 2.844 | 3 06 | 3.28 | 3.50 |
| 3 3/4 | .234 | .469 | .703 | .938 | 1.172 | 1 406 | 1 641 | 1 875 | 2.109 | 2 344 | 2 578 | 2 813 | 3 047 | 3.28 | 3 52 | 3.75 |
| 4 | .250 | .500 | .750 | 1.000 | 1 250 | 1.500 | 1 750 | 2 000 | 2.250 | 2 500 | 2.750 | 3 000 | 3.250 | 3 50 | 3.75 | 4.00 |
| 4 1/4 | .266 | .531 | .797 | 1 063 | 1 328 | 1 594 | 1 859 | 2 125 | 2.391 | 2.656 | 2 922 | 3 188 | 3 453 | 3 72 | 3 98 | 4 25 |
| 4 1/2 | .281 | .563 | .844 | 1 125 | 1 406 | 1 688 | 1 969 | 2 250 | 2.531 | 2 813 | 3 094 | 3 375 | 3 656 | 3 94 | 4 22 | 4.50 |
| 4 3/4 | .297 | .594 | .891 | 1 188 | 1 484 | 1 781 | 2 078 | 2 375 | 2 672 | 2 969 | 3 266 | 3 563 | 3 859 | 4 16 | 4 45 | 4.75 |
| 5 | .313 | .625 | .938 | 1.250 | 1.563 | 1 875 | 2 188 | 2 500 | 2 813 | 3 125 | 3 438 | 3 750 | 4 063 | 4 38 | 4 69 | 5.00 |
| 5 1/4 | .328 | .656 | .984 | 1 313 | 1 641 | 1 969 | 2 297 | 2 625 | 2 953 | 3 281 | 3 609 | 3 938 | 4 266 | 4 59 | 4 92 | 5 25 |
| 5 1/2 | .344 | .688 | 1 031 | 1 375 | 1 719 | 2 063 | 2 406 | 2.750 | 3 094 | 3.438 | 3 781 | 4 125 | 4 469 | 4 81 | 5 16 | 5.50 |
| 5 3/4 | .359 | .719 | 1.078 | 1 438 | 1 797 | 2 156 | 2 516 | 2 875 | 3 234 | 3 594 | 3 953 | 4 313 | 4 672 | 5 03 | 5 39 | 5 75 |
| 6 | .375 | .750 | 1.125 | 1 500 | 1.875 | 2 250 | 2 625 | 3 000 | 3 375 | 3 750 | 4 125 | 4 500 | 4 875 | 5 25 | 5 63 | 6.00 |
| 6 1/4 | .391 | .781 | 1.172 | 1 563 | 1 953 | 2 344 | 2 734 | 3 125 | 3 516 | 3 906 | 4 297 | 4 688 | 5 078 | 5 47 | 5 86 | 6.25 |
| 6 1/2 | .406 | .813 | 1 219 | 1 625 | 2 031 | 2 438 | 2 844 | 3 250 | 3 656 | 4 063 | 4 469 | 4 875 | 5 281 | 5 69 | 6 09 | 6.50 |
| 6 3/4 | .422 | .844 | 1 266 | 1 688 | 2 109 | 2 531 | 2 953 | 3 375 | 3.797 | 4 219 | 4 641 | 5 063 | 5 484 | 5 91 | 6 33 | 6 75 |
| 7 | .438 | .875 | 1.313 | 1.750 | 2 188 | 2 625 | 3 063 | 3.500 | 3 938 | 4 375 | 4 813 | 5 250 | 5 688 | 6 13 | 6 56 | 7.00 |
| 7 1/4 | .453 | .906 | 1.359 | 1 813 | 2 266 | 2 719 | 3 172 | 3 625 | 4 078 | 4 531 | 4 984 | 5 438 | 5 891 | 6 34 | 6 80 | 7 25 |
| 7 1/2 | .469 | .938 | 1.406 | 1 875 | 2.344 | 2 813 | 3 281 | 3 750 | 4 219 | 4 688 | 5 156 | 5 625 | 6 094 | 6 56 | 7 03 | 7 50 |
| 7 3/4 | .484 | .969 | 1 453 | 1 938 | 2 422 | 2 906 | 3 391 | 3 875 | 4 359 | 4 844 | 5 328 | 5 813 | 6 297 | 6 78 | 7 27 | 7.75 |
| 8 | .500 | 1 000 | 1 500 | 2 000 | 2.500 | 3 000 | 3 500 | 4 000 | 4 500 | 5 000 | 5 500 | 6 000 | 6 500 | 7 00 | 7.50 | 8 00 |
| 8 1/4 | .516 | 1 031 | 1.547 | 2 063 | 2 578 | 3 094 | 3 609 | 4 125 | 4 641 | 5 156 | 5 672 | 6 188 | 6 703 | 7 22 | 7 73 | 8 25 |
| 8 1/2 | .531 | 1 063 | 1.594 | 2 125 | 2 656 | 3 188 | 3.719 | 4 250 | 4 781 | 5 313 | 5 844 | 6 375 | 6 906 | 7 44 | 7 97 | 8 50 |
| 8 3/4 | .547 | 1 094 | 1.641 | 2 188 | 2 734 | 3 281 | 3.828 | 4 375 | 4.922 | 5 469 | 6 016 | 6 563 | 7 109 | 7 66 | 8 20 | 8 75 |
| 9 | .563 | 1.125 | 1.688 | 2 250 | 2 813 | 3 375 | 3 938 | 4 500 | 5 063 | 5 625 | 6 188 | 6.750 | 7 313 | 7 88 | 8 44 | 9 00 |
| 9 1/4 | .578 | 1.156 | 1.734 | 2 313 | 2 891 | 3 469 | 4 047 | 4 625 | 5 203 | 5 781 | 6 359 | 6 938 | 7 516 | 8 09 | 8 67 | 9 25 |
| 9 1/2 | .594 | 1.188 | 1 781 | 2 375 | 2 969 | 3 563 | 4 156 | 4 750 | 5 344 | 5 938 | 6 531 | 7 125 | 7 719 | 8 31 | 8 91 | 9 50 |
| 9 3/4 | .609 | 1 219 | 1 828 | 2 438 | 3 047 | 3 656 | 4 266 | 4 875 | 5 484 | 6 094 | 6 703 | 7 313 | 7 922 | 8.53 | 9 14 | 9 75 |
| 10 | .625 | 1 250 | 1 875 | 2 500 | 3.125 | 3 750 | 4 375 | 5 000 | 5 625 | 6.250 | 6 875 | 7 500 | 8 125 | 8 75 | 9.38 | 10.00 |
| 10 1/4 | .641 | 1.281 | 1 922 | 2 563 | 3 203 | 3 844 | 4 484 | 5 125 | 5 766 | 6 406 | 7 047 | 7 688 | 8 328 | 8 97 | 9 61 | 10 25 |
| 10 1/2 | .656 | 1 313 | 1 969 | 2 625 | 3 281 | 3 938 | 4 594 | 5 250 | 5 906 | 6 563 | 7 219 | 7 875 | 8 531 | 9 19 | 9 84 | 10 50 |
| 10 3/4 | .672 | 1 344 | 2 016 | 2 688 | 3 359 | 4 031 | 4 703 | 5 375 | 6 047 | 6 719 | 7 391 | 8 063 | 8 734 | 9 41 | 10.08 | 10 75 |
| 11 | .688 | 1.375 | 2 063 | 2 750 | 3 438 | 4 125 | 4 813 | 5 500 | 6 188 | 6 875 | 7 563 | 8 250 | 8 938 | 9.63 | 10 31 | 11.00 |
| 11 1/4 | .703 | 1.406 | 2 109 | 2 813 | 3 516 | 4 219 | 4 922 | 5 625 | 6 328 | 7 031 | 7 734 | 8 438 | 9 141 | 9.84 | 10 55 | 11.25 |
| 11 1/2 | .719 | 1.438 | 2 156 | 2 875 | 3 594 | 4 313 | 5 031 | 5 750 | 6 469 | 7 188 | 7 906 | 8 625 | 9 344 | 10.06 | 10 78 | 11.50 |
| 11 3/4 | .734 | 1.469 | 2.203 | 2 938 | 3 672 | 4 406 | 5 141 | 5 875 | 6 609 | 7 344 | 8 078 | 8 813 | 9.547 | 10.28 | 11 02 | 11.75 |
| 12 | .750 | 1.500 | 2 250 | 3 000 | 3 750 | 4 500 | 5 250 | 6 000 | 6.750 | 7 500 | 8 250 | 9 000 | 9 750 | 10 50 | 11 25 | 12.00 |
| 12 1/2 | .781 | 1 563 | 2 344 | 3 13 | 3 91 | 4 69 | 5 47 | 6 25 | 7 03 | 7 81 | 8.59 | 9.38 | 10 16 | 10 94 | 11 72 | 12 50 |
| 13 | .813 | 1 625 | 2 438 | 3 25 | 4 06 | 4 88 | 5 69 | 6 50 | 7 31 | 8 13 | 8 94 | 9 75 | 10.56 | 11.38 | 12 19 | 13.00 |
| 13 1/2 | .844 | 1.688 | 2 531 | 3 38 | 4 22 | 5 06 | 5 91 | 6 75 | 7 59 | 8 44 | 9 28 | 10.13 | 10 97 | 11.81 | 12.66 | 13.50 |
| 14 | .875 | 1 750 | 2 625 | 3 50 | 4 38 | 5 25 | 6.13 | 7.00 | 7 88 | 8 75 | 9 63 | 10.50 | 11.38 | 12.25 | 13.13 | 14.00 |
| 14 1/2 | .906 | 1 813 | 2 719 | 3 63 | 4 53 | 5 44 | 6 34 | 7.25 | 8 16 | 9 06 | 9 97 | 10 88 | 11.78 | 12.69 | 13.59 | 14 50 |
| 15 | .938 | 1 875 | 2 813 | 3 75 | 4 69 | 5 63 | 6 56 | 7 50 | 8 44 | 9 38 | 10 31 | 11 25 | 12.19 | 13.13 | 14 06 | 15.00 |
| 15 1/2 | .969 | 1.938 | 2 906 | 3 88 | 4 84 | 5 81 | 6.78 | 7.75 | 8 72 | 9 69 | 10 66 | 11 63 | 12.59 | 13.56 | 14.53 | 15.50 |
| 16 | 1 000 | 2 000 | 3 000 | 4 00 | 5 00 | 6 00 | 7.00 | 8 00 | 9.00 | 10 00 | 11 00 | 12.00 | 13.00 | 14.00 | 15 00 | 16.00 |
| 16 1/2 | 1 031 | 2 063 | 3 094 | 4 13 | 5 16 | 6 19 | 7.22 | 8 25 | 9.28 | 10 31 | 11 34 | 12.38 | 13.41 | 14.44 | 15 47 | 16.50 |
| 17 | 1 063 | 2.125 | 3 188 | 4 25 | 5 31 | 6 38 | 7.44 | 8.50 | 9.56 | 10 63 | 11 69 | 12.75 | 13 81 | 14 88 | 15.94 | 17.00 |
| 17 1/2 | 1 094 | 2 188 | 3 281 | 4 38 | 5.47 | 6 56 | 7.66 | 8 75 | 9.84 | 10 94 | 12 03 | 13 13 | 14.22 | 15 31 | 16.41 | 17.50 |
| 18 | 1 125 | 2 250 | 3 375 | 4 50 | 5.63 | 6.75 | 7.88 | 9 00 | 10.13 | 11.25 | 12 38 | 13.50 | 14.63 | 15.75 | 16 88 | 18.00 |
| 18 1/2 | 1 156 | 2 313 | 3 469 | 4 63 | 5 78 | 6 94 | 8.09 | 9 25 | 10 41 | 11.56 | 12.72 | 13.88 | 15.03 | 16.19 | 17.34 | 18 50 |
| 19 | 1 188 | 2.375 | 3 563 | 4 75 | 5 94 | 7.13 | 8.31 | 9 50 | 10 69 | 11 88 | 13 06 | 14 25 | 15.44 | 16.63 | 17.81 | 19 00 |
| 19 1/2 | 1 219 | 2 438 | 3 656 | 4 88 | 6 09 | 7.31 | 8.53 | 9.75 | 10.97 | 12.19 | 13.41 | 14.63 | 15.84 | 17.06 | 18 28 | 19.50 |
| 20 | 1.250 | 2 500 | 3 750 | 5 00 | 6 25 | 7.50 | 8.75 | 10 00 | 11.25 | 12.50 | 13 75 | 15.00 | 16.25 | 17.50 | 18.75 | 20.00 |
| 20 1/2 | 1 281 | 2 563 | 3 844 | 5 13 | 6 41 | 7 69 | 8 97 | 10.25 | 11.53 | 12.81 | 14 09 | 15.38 | 16.66 | 17.94 | 19.22 | 20.50 |
| 21 | 1 313 | 2 625 | 3 938 | 5 25 | 6.56 | 7 88 | 9.19 | 10.50 | 11.81 | 13.13 | 14.44 | 15.75 | 17 06 | 18.38 | 19.69 | 21.00 |
| 21 1/2 | 1 344 | 2 688 | 4 031 | 5.38 | 6.72 | 8.06 | 9.41 | 10.75 | 12.09 | 13 44 | 14.78 | 16.13 | 17.47 | 18.81 | 20.16 | 21.50 |
| 22 | 1 375 | 2 750 | 4 125 | 5.50 | 6.88 | 8.25 | 9 63 | 11.00 | 12 38 | 13.75 | 15.13 | 16.50 | 17.88 | 19.25 | 20.63 | 22.00 |

# AREAS OF RECTANGULAR SECTIONS

SQUARE INCHES

| Width, inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 22½ | 1.406 | 2.813 | 4.219 | 5.63 | 7.03 | 8.44 | 9.84 | 11.25 | 12.66 | 14.06 | 15.47 | 16.88 | 18.28 | 19.69 | 21.09 | 22.50 |
| 23 | 1.438 | 2.875 | 4.313 | 5.75 | 7.19 | 8.63 | 10.06 | 11.50 | 12.94 | 14.38 | 15.81 | 17.25 | 18.69 | 20.13 | 21.56 | 23.00 |
| 23½ | 1.469 | 2.938 | 4.406 | 5.88 | 7.34 | 8.81 | 10.28 | 11.75 | 13.22 | 14.69 | 16.16 | 17.63 | 19.09 | 20.56 | 22.03 | 23.50 |
| 24 | 1.500 | 3.000 | 4.500 | 6.00 | 7.50 | 9.00 | 10.50 | 12.00 | 13.50 | 15.00 | 16.50 | 18.00 | 19.50 | 21.00 | 22.50 | 24.00 |
| 25 | 1.563 | 3.125 | 4.688 | 6.25 | 7.81 | 9.38 | 10.94 | 12.50 | 14.06 | 15.63 | 17.19 | 18.75 | 20.31 | 21.88 | 23.44 | 25.00 |
| 26 | 1.625 | 3.250 | 4.875 | 6.50 | 8.13 | 9.75 | 11.38 | 13.00 | 14.63 | 16.25 | 17.88 | 19.50 | 21.13 | 22.75 | 24.38 | 26.00 |
| 27 | 1.688 | 3.375 | 5.063 | 6.75 | 8.44 | 10.13 | 11.81 | 13.50 | 15.19 | 16.88 | 18.56 | 20.25 | 21.94 | 23.63 | 25.31 | 27.00 |
| 28 | 1.750 | 3.500 | 5.250 | 7.00 | 8.75 | 10.50 | 12.25 | 14.00 | 15.75 | 17.50 | 19.25 | 21.00 | 22.75 | 24.50 | 26.25 | 28.00 |
| 29 | 1.813 | 3.625 | 5.438 | 7.25 | 9.06 | 10.88 | 12.69 | 14.50 | 16.31 | 18.13 | 19.94 | 21.75 | 23.56 | 25.38 | 27.19 | 29.00 |
| 30 | 1.875 | 3.750 | 5.625 | 7.50 | 9.38 | 11.25 | 13.13 | 15.00 | 16.88 | 18.75 | 20.63 | 22.50 | 24.38 | 26.25 | 28.13 | 30.00 |
| 31 | 1.938 | 3.875 | 5.813 | 7.75 | 9.69 | 11.63 | 13.56 | 15.50 | 17.44 | 19.38 | 21.31 | 23.25 | 25.19 | 27.13 | 29.06 | 31.00 |
| 32 | 2.000 | 4.000 | 6.000 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | 28.00 | 30.00 | 32.00 |
| 33 | 2.063 | 4.125 | 6.188 | 8.25 | 10.31 | 12.38 | 14.44 | 16.50 | 18.56 | 20.63 | 22.69 | 24.75 | 26.81 | 28.88 | 30.94 | 33.00 |
| 34 | 2.125 | 4.250 | 6.375 | 8.50 | 10.63 | 12.75 | 14.88 | 17.00 | 19.13 | 21.25 | 23.38 | 25.50 | 27.63 | 29.75 | 31.88 | 34.00 |
| 35 | 2.188 | 4.375 | 6.563 | 8.75 | 10.94 | 13.13 | 15.31 | 17.50 | 19.69 | 21.88 | 24.06 | 26.25 | 28.44 | 30.63 | 32.81 | 35.00 |
| 36 | 2.250 | 4.500 | 6.750 | 9.00 | 11.25 | 13.50 | 15.75 | 18.00 | 20.25 | 22.50 | 24.75 | 27.00 | 29.25 | 31.50 | 33.75 | 36.00 |
| 37 | 2.313 | 4.625 | 6.938 | 9.25 | 11.56 | 13.88 | 16.19 | 18.50 | 20.81 | 23.13 | 25.44 | 27.75 | 30.06 | 32.38 | 34.69 | 37.00 |
| 38 | 2.375 | 4.750 | 7.125 | 9.50 | 11.88 | 14.25 | 16.63 | 19.00 | 21.38 | 23.75 | 26.13 | 28.50 | 30.88 | 33.25 | 35.63 | 38.00 |
| 39 | 2.438 | 4.875 | 7.313 | 9.75 | 12.19 | 14.63 | 17.06 | 19.50 | 21.94 | 24.38 | 26.81 | 29.25 | 31.69 | 34.13 | 36.56 | 39.00 |
| 40 | 2.500 | 5.000 | 7.500 | 10.00 | 12 50 | 15.00 | 17.50 | 20 00 | 22.50 | 25.00 | 27.50 | 30.00 | 32.50 | 35.00 | 37.50 | 40.00 |
| 41 | 2.563 | 5.125 | 7.688 | 10.25 | 12 81 | 15.38 | 17.94 | 20.50 | 23.06 | 25.63 | 28.19 | 30.75 | 33.31 | 35.88 | 38.44 | 41.00 |
| 42 | 2.625 | 5.250 | 7.875 | 10.50 | 13.13 | 15.75 | 18.38 | 21.00 | 23.63 | 26.25 | 28.88 | 31.50 | 34.13 | 36.75 | 39.38 | 42.00 |
| 43 | 2.688 | 5.375 | 8.063 | 10.75 | 13.44 | 16.13 | 18.81 | 21.50 | 24.19 | 26.88 | 29.56 | 32.25 | 34.94 | 37.63 | 40.31 | 43.00 |
| 44 | 2.750 | 5.500 | 8.250 | 11.00 | 13.75 | 16.50 | 19.25 | 22.00 | 24.75 | 27.50 | 30.25 | 33.00 | 35.75 | 38.50 | 41.25 | 44.00 |
| 45 | 2.813 | 5.625 | 8.438 | 11.25 | 14.06 | 16.88 | 19 69 | 22.50 | 25.31 | 28.13 | 30.94 | 33.75 | 36.56 | 39.38 | 42.19 | 45.00 |
| 46 | 2.875 | 5.750 | 8.625 | 11.50 | 14 38 | 17.25 | 20 13 | 23.00 | 25.88 | 28.75 | 31.63 | 34.50 | 37.38 | 40.25 | 43.13 | 46.00 |
| 47 | 2.938 | 5 875 | 8.813 | 11.75 | 14 69 | 17.63 | 20.56 | 23.50 | 26.44 | 29.38 | 32.31 | 35.25 | 38.19 | 41.13 | 44.06 | 47.00 |
| 48 | 3.000 | 6.000 | 9.000 | 12.00 | 15.00 | 18.00 | 21.00 | 24.00 | 27.00 | 30.00 | 33.00 | 36.00 | 39.00 | 42.00 | 45.00 | 48.00 |
| 49 | 3.06 | 6.13 | 9.19 | 12.25 | 15.31 | 18.38 | 21.44 | 24.50 | 27.56 | 30.63 | 33.69 | 36.75 | 39.81 | 42.88 | 45.94 | 49.00 |
| 50 | 3.13 | 6.25 | 9.38 | 12.50 | 15.63 | 18.75 | 21.88 | 25.00 | 28.13 | 31.25 | 34.38 | 37.50 | 40.63 | 43 75 | 46.88 | 50.00 |
| 51 | 3.19 | 6.38 | 9.56 | 12.75 | 15.94 | 19.13 | 22.31 | 25.50 | 28.69 | 31.88 | 35.06 | 38.25 | 41.44 | 44.63 | 47.81 | 51.00 |
| 52 | 3.25 | 6.50 | 9.75 | 13.00 | 16.25 | 19.50 | 22.75 | 26.00 | 29.25 | 32.50 | 35.75 | 39.00 | 42.25 | 45.50 | 48.75 | 52.00 |
| 53 | 3.31 | 6.63 | 9.94 | 13.25 | 16.56 | 19.88 | 23.19 | 26.50 | 29.81 | 33.13 | 36.44 | 39.75 | 43.06 | 46.38 | 49.69 | 53.00 |
| 54 | 3.38 | 6.75 | 10.13 | 13.50 | 16.88 | 20.25 | 23.63 | 27.00 | 30.38 | 33.75 | 37.13 | 40.50 | 43.88 | 47.25 | 50.63 | 54.00 |
| 55 | 3.44 | 6.88 | 10.31 | 13.75 | 17.19 | 20.63 | 24.06 | 27.50 | 30.94 | 34.38 | 37.81 | 41.25 | 44.69 | 48.13 | 51.56 | 55.00 |
| 56 | 3.50 | 7.00 | 10.50 | 14.00 | 17.50 | 21.00 | 24.50 | 28.00 | 31.50 | 35.00 | 38.50 | 42.00 | 45.50 | 49.00 | 52.50 | 56.00 |
| 57 | 3.56 | 7.13 | 10.69 | 14.25 | 17.81 | 21.38 | 24.94 | 28.50 | 32.06 | 35.63 | 39.19 | 42.75 | 46.31 | 49.88 | 53.44 | 57.00 |
| 58 | 3.63 | 7.25 | 10.88 | 14.50 | 18.13 | 21.75 | 25.38 | 29.00 | 32.63 | 36.25 | 39.88 | 43.50 | 47.13 | 50.75 | 54.38 | 58.00 |
| 59 | 3.69 | 7.38 | 11.06 | 14.75 | 18.44 | 22.13 | 25.81 | 29.50 | 33.19 | 36.88 | 40.56 | 44.25 | 47.94 | 51.63 | 55.31 | 59.00 |
| 60 | 3.75 | 7.50 | 11.25 | 15.00 | 18.75 | 22.50 | 26.25 | 30.00 | 33.75 | 37.50 | 41.25 | 45.00 | 48.75 | 52.50 | 56.25 | 60.00 |
| 61 | 3.81 | 7.63 | 11.44 | 15.25 | 19.06 | 22.88 | 26.69 | 30.50 | 34.31 | 38.13 | 41.94 | 45.75 | 49.56 | 53 38 | 57.19 | 61.00 |
| 62 | 3.88 | 7.75 | 11.63 | 15.50 | 19.38 | 23.25 | 27.13 | 31.00 | 34.88 | 38.75 | 42.63 | 46.50 | 50.38 | 54.25 | 58.13 | 62.00 |
| 63 | 3.94 | 7.88 | 11.81 | 15.75 | 19 69 | 23.63 | 27.56 | 31.50 | 35.44 | 39.38 | 43.31 | 47.25 | 51.19 | 55.13 | 59.06 | 63.00 |
| 64 | 4.00 | 8.00 | 12.00 | 16.00 | 20 00 | 24.00 | 28.00 | 32.00 | 36 00 | 40.00 | 44.00 | 48 00 | 52.00 | 56.00 | 60 00 | 64.00 |
| 65 | 4.06 | 8.13 | 12.19 | 16.25 | 20.31 | 24.38 | 28.44 | 32.50 | 36.56 | 40.63 | 44 69 | 48.75 | 52.81 | 56.88 | 60.94 | 65.00 |
| 66 | 4.13 | 8.25 | 12.38 | 16.50 | 20.63 | 24.75 | 28.88 | 33.00 | 37.13 | 41.25 | 45 38 | 49.50 | 53.63 | 57.75 | 61.88 | 66.00 |
| 67 | 4.19 | 8.38 | 12.56 | 16 75 | 20.94 | 25.13 | 29.31 | 33.50 | 37.69 | 41.88 | 46.06 | 50.25 | 54.44 | 58.63 | 62.81 | 67.00 |
| 68 | 4.25 | 8.50 | 12 75 | 17.00 | 21.25 | 25.50 | 29.75 | 34.00 | 38.25 | 42.50 | 46.75 | 51.00 | 55.25 | 59.50 | 63.75 | 68.00 |
| 69 | 4.31 | 8.63 | 12.94 | 17.25 | 21.56 | 25.88 | 30.19 | 34 50 | 38.81 | 43 13 | 47.44 | 51.75 | 56.06 | 60 38 | 64.69 | 69.00 |
| 70 | 4.38 | 8.75 | 13.13 | 17.50 | 21.88 | 26.25 | 30.63 | 35.00 | 39 38 | 43.75 | 48.13 | 52 50 | 56.88 | 61.25 | 65.63 | 70.00 |
| 71 | 4.44 | 8.88 | 13.31 | 17.75 | 22.19 | 26.63 | 31.06 | 35.50 | 39 94 | 44.38 | 48 81 | 53 25 | 57.69 | 62.13 | 66 56 | 71.00 |
| 72 | 4.50 | 9.00 | 13.50 | 18.00 | 22.50 | 27.00 | 31.50 | 36.00 | 40.50 | 45.00 | 49 50 | 54.00 | 58.50 | 63.00 | 67.50 | 72.00 |
| 73 | 4.56 | 9.13 | 13.69 | 18.25 | 22.81 | 27.38 | 31.94 | 36.50 | 41.06 | 45.63 | 50.19 | 54.75 | 59.31 | 63.88 | 68 44 | 73.00 |
| 74 | 4.63 | 9.25 | 13.88 | 18.50 | 23.13 | 27.75 | 32.38 | 37.00 | 41.63 | 46 25 | 50 88 | 55.50 | 60.13 | 64.75 | 69.38 | 74 00 |
| 75 | 4.69 | 9.38 | 14.06 | 18.75 | 23.44 | 28.13 | 32.81 | 37.50 | 42.19 | 46.88 | 51.56 | 56 25 | 60.94 | 65.63 | 70.31 | 75.00 |
| 76 | 4.75 | 9.50 | 14.25 | 19.00 | 23.75 | 28.50 | 33.25 | 38.00 | 42 75 | 47.50 | 52.25 | 57.00 | 61.75 | 66.50 | 71.25 | 76 00 |
| 78 | 4.88 | 9.75 | 14.63 | 19.50 | 24.38 | 29.25 | 34 13 | 39.00 | 43.88 | 48.75 | 53.63 | 58.50 | 63.38 | 68.25 | 73 13 | 78 00 |
| 80 | 5.00 | 10.00 | 15.00 | 20.00 | 25.00 | 30.00 | 35.00 | 40 00 | 45.00 | 50.00 | 55.00 | 60.00 | 65.00 | 70.00 | 75 00 | 80.00 |
| 82 | 5.13 | 10.25 | 15.38 | 20.50 | 25.63 | 30.75 | 35.88 | 41.00 | 46.13 | 51.25 | 56.38 | 61 50 | 66 63 | 71.75 | 76.88 | 82.00 |
| 84 | 5.25 | 10.50 | 15.75 | 21.00 | 26.25 | 31.50 | 36.75 | 42.00 | 47.25 | 52.50 | 57.75 | 63.00 | 68.25 | 73.50 | 78.75 | 84.00 |
| 86 | 5.38 | 10.75 | 16.13 | 21 50 | 26.88 | 32.25 | 37.63 | 43.00 | 48.38 | 53.75 | 59.13 | 64.50 | 69 88 | 75.25 | 80.63 | 86.00 |
| 88 | 5.50 | 11.00 | 16.50 | 22.00 | 27.50 | 33.00 | 38.50 | 44.00 | 49.50 | 55.00 | 60.50 | 66.00 | 71.50 | 77.00 | 82 50 | 88.00 |
| 90 | 5.63 | 11.25 | 16.88 | 22.50 | 28.13 | 33.75 | 39.38 | 45.00 | 50.63 | 56.25 | 61.88 | 67.50 | 73.13 | 78.75 | 84.38 | 90.00 |
| 92 | 5.75 | 11.50 | 17 25 | 23 00 | 28.75 | 34.50 | 40.25 | 46.00 | 51.75 | 57.50 | 63.25 | 69 00 | 74.75 | 80.50 | 86.25 | 92.00 |
| 94 | 5.88 | 11.75 | 17.63 | 23.50 | 29 38 | 35.25 | 41.13 | 47.00 | 52.88 | 58.75 | 64.63 | 70.50 | 76.38 | 82.25 | 88.13 | 94.00 |
| 96 | 6.00 | 12.00 | 18.00 | 24.00 | 30.00 | 36.00 | 42.00 | 48.00 | 54.00 | 60.00 | 66.00 | 72.00 | 78.00 | 84.00 | 90.00 | 96.00 |
| 98 | 6 13 | 12.25 | 18.38 | 24.50 | 30.63 | 36.75 | 42.88 | 49.00 | 55.13 | 61.25 | 67.38 | 73.50 | 79.63 | 85.75 | 91.88 | 98.00 |
| 100 | 6.25 | 12.50 | 18.75 | 25.00 | 31.25 | 37.50 | 43.75 | 50.00 | 56.25 | 62.50 | 68.75 | 75.00 | 81.25 | 87.50 | 93.75 | 100 0 |

# WEIGHTS OF FLAT ROLLED STEEL.

POUNDS PER LINEAR FOOT

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 1/4 | .053 | .106 | .159 | .213 | .27 | .32 | .37 | .43 | .48 | .53 | .58 | .64 | 69 | .74 | .80 | .85 |
| 1/2 | .106 | .213 | .319 | .425 | .53 | .64 | .74 | .85 | .96 | 1.06 | 1.17 | 1.28 | 1.38 | 1.49 | 1.59 | 1.70 |
| 3/4 | .159 | .319 | .478 | .638 | .80 | .96 | 1.12 | 1.28 | 1.43 | 1.59 | 1.75 | 1.91 | 2.07 | 2.23 | 2.39 | 2.55 |
| 1 | .213 | .425 | .638 | .850 | 1.06 | 1.28 | 1.49 | 1.70 | 1.91 | 2.13 | 2.34 | 2.55 | 2.76 | 2.98 | 3.19 | 3.40 |
| 1 1/4 | .266 | .531 | .797 | 1.063 | 1.33 | 1.59 | 1.86 | 2.13 | 2.39 | 2.66 | 2.92 | 3.19 | 3.45 | 3.72 | 3.98 | 4.25 |
| 1 1/2 | .319 | .638 | .956 | 1.275 | 1.59 | 1.91 | 2.23 | 2.55 | 2.87 | 3.19 | 3.51 | 3.83 | 4.14 | 4.46 | 4.78 | 5.10 |
| 1 3/4 | .372 | .744 | 1.116 | 1.488 | 1.86 | 2.23 | 2.60 | 2.98 | 3.35 | 3.72 | 4.09 | 4.46 | 4.83 | 5.21 | 5.58 | 5.95 |
| 2 | .425 | .850 | 1.275 | 1.700 | 2.13 | 2.55 | 2.98 | 3.40 | 3.83 | 4.25 | 4.68 | 5.10 | 5.53 | 5.95 | 6.38 | 6.80 |
| 2 1/4 | .478 | .956 | 1.434 | 1.913 | 2.39 | 2.87 | 3.35 | 3.83 | 4.30 | 4.78 | 5.26 | 5.74 | 6.22 | 6.69 | 7.17 | 7.65 |
| 2 1/2 | .531 | 1.063 | 1.594 | 2.125 | 2.66 | 3.19 | 3.72 | 4.25 | 4.78 | 5.31 | 5.84 | 6.38 | 6.91 | 7.44 | 7.97 | 8.50 |
| 2 3/4 | .584 | 1.169 | 1.753 | 2.338 | 2.92 | 3.51 | 4.09 | 4.68 | 5.26 | 5.84 | 6.43 | 7.01 | 7.60 | 8.18 | 8.77 | 9.35 |
| 3 | .638 | 1.275 | 1.913 | 2.550 | 3.19 | 3.83 | 4.46 | 5.10 | 5.74 | 6.38 | 7.01 | 7.65 | 8.29 | 8.93 | 9.56 | 10.20 |
| 3 1/4 | .691 | 1.381 | 2.072 | 2.763 | 3.45 | 4.14 | 4.83 | 5.53 | 6.22 | 6.91 | 7.60 | 8.29 | 8.98 | 9.67 | 10.36 | 11.05 |
| 3 1/2 | .744 | 1.488 | 2.231 | 2.975 | 3.72 | 4.46 | 5.21 | 5.95 | 6.69 | 7.44 | 8.18 | 8.93 | 9.67 | 10.41 | 11.16 | 11.90 |
| 3 3/4 | .797 | 1.594 | 2.391 | 3.188 | 3.98 | 4.78 | 5.58 | 6.38 | 7.17 | 7.97 | 8.77 | 9.56 | 10.36 | 11.16 | 11.95 | 12.75 |
| 4 | .850 | 1.700 | 2.550 | 3.400 | 4.25 | 5.10 | 5.95 | 6.80 | 7.65 | 8.50 | 9.35 | 10.20 | 11.05 | 11.90 | 12.75 | 13.60 |
| 4 1/4 | .903 | 1.806 | 2.709 | 3.613 | 4.52 | 5.42 | 6.32 | 7.23 | 8.13 | 9.03 | 9.93 | 10.84 | 11.74 | 12.64 | 13.55 | 14.45 |
| 4 1/2 | .956 | 1.913 | 2.869 | 3.825 | 4.78 | 5.74 | 6.69 | 7.65 | 8.61 | 9.56 | 10.52 | 11.48 | 12.43 | 13.39 | 14.34 | 15.30 |
| 4 3/4 | 1.009 | 2.019 | 3.028 | 4.038 | 5.05 | 6.06 | 7.07 | 8.08 | 9.08 | 10.09 | 11.10 | 12.11 | 13.12 | 14.13 | 15.14 | 16.15 |
| 5 | 1.063 | 2.125 | 3.188 | 4.250 | 5.31 | 6.38 | 7.44 | 8.50 | 9.56 | 10.63 | 11.69 | 12.75 | 13.81 | 14.88 | 15.94 | 17.00 |
| 5 1/4 | 1.116 | 2.231 | 3.347 | 4.463 | 5.58 | 6.69 | 7.81 | 8.93 | 10.04 | 11.16 | 12.27 | 13.39 | 14.50 | 15.62 | 16.73 | 17.85 |
| 5 1/2 | 1.169 | 2.338 | 3.506 | 4.675 | 5.84 | 7.01 | 8.18 | 9.35 | 10.52 | 11.69 | 12.86 | 14.03 | 15.19 | 16.36 | 17.53 | 18.70 |
| 5 3/4 | 1.222 | 2.444 | 3.666 | 4.888 | 6.11 | 7.33 | 8.55 | 9.78 | 11.00 | 12.22 | 13.44 | 14.66 | 15.88 | 17.11 | 18.33 | 19.55 |
| 6 | 1.275 | 2.550 | 3.825 | 5.100 | 6.38 | 7.65 | 8.93 | 10.20 | 11.48 | 12.75 | 14.03 | 15.30 | 16.58 | 17.85 | 19.13 | 20.40 |
| 6 1/4 | 1.328 | 2.656 | 3.984 | 5.313 | 6.64 | 7.97 | 9.30 | 10.63 | 11.95 | 13.28 | 14.61 | 15.94 | 17.27 | 18.59 | 19.92 | 21.25 |
| 6 1/2 | 1.381 | 2.763 | 4.144 | 5.525 | 6.91 | 8.29 | 9.67 | 11.05 | 12.43 | 13.81 | 15.19 | 16.58 | 17.96 | 19.34 | 20.72 | 22.10 |
| 6 3/4 | 1.434 | 2.869 | 4.303 | 5.738 | 7.17 | 8.61 | 10.04 | 11.48 | 12.91 | 14.34 | 15.78 | 17.21 | 18.65 | 20.08 | 21.52 | 22.95 |
| 7 | 1.488 | 2.975 | 4.463 | 5.950 | 7.44 | 8.93 | 10.41 | 11.90 | 13.39 | 14.88 | 16.36 | 17.85 | 19.34 | 20.83 | 22.31 | 23.80 |
| 7 1/4 | 1.541 | 3.081 | 4.622 | 6.163 | 7.70 | 9.24 | 10.78 | 12.33 | 13.87 | 15.41 | 16.95 | 18.49 | 20.03 | 21.57 | 23.11 | 24.65 |
| 7 1/2 | 1.594 | 3.188 | 4.781 | 6.375 | 7.97 | 9.56 | 11.16 | 12.75 | 14.34 | 15.94 | 17.53 | 19.13 | 20.72 | 22.31 | 23.91 | 25.50 |
| 7 3/4 | 1.647 | 3.294 | 4.941 | 6.588 | 8.23 | 9.88 | 11.53 | 13.18 | 14.82 | 16.47 | 18.12 | 19.76 | 21.41 | 23.06 | 24.70 | 26.35 |
| 8 | 1.700 | 3.400 | 5.100 | 6.800 | 8.50 | 10.20 | 11.90 | 13.60 | 15.30 | 17.00 | 18.70 | 20.40 | 22.10 | 23.80 | 25.50 | 27.20 |
| 8 1/4 | 1.753 | 3.506 | 5.259 | 7.013 | 8.77 | 10.52 | 12.27 | 14.03 | 15.78 | 17.53 | 19.28 | 21.04 | 22.79 | 24.54 | 26.30 | 28.05 |
| 8 1/2 | 1.806 | 3.613 | 5.419 | 7.225 | 9.03 | 10.84 | 12.64 | 14.45 | 16.26 | 18.06 | 19.87 | 21.68 | 23.48 | 25.29 | 27.09 | 28.90 |
| 8 3/4 | 1.859 | 3.719 | 5.578 | 7.438 | 9.30 | 11.16 | 13.02 | 14.88 | 16.73 | 18.59 | 20.45 | 22.31 | 24.17 | 26.03 | 27.89 | 29.75 |
| 9 | 1.913 | 3.825 | 5.738 | 7.650 | 9.56 | 11.48 | 13.39 | 15.30 | 17.21 | 19.13 | 21.04 | 22.95 | 24.86 | 26.78 | 28.69 | 30.60 |
| 9 1/4 | 1.966 | 3.931 | 5.897 | 7.863 | 9.83 | 11.79 | 13.76 | 15.73 | 17.69 | 19.66 | 21.62 | 23.59 | 25.55 | 27.52 | 29.48 | 31.45 |
| 9 1/2 | 2.019 | 4.038 | 6.056 | 8.075 | 10.09 | 12.11 | 14.13 | 16.15 | 18.17 | 20.19 | 22.21 | 24.23 | 26.24 | 28.26 | 30.28 | 32.30 |
| 9 3/4 | 2.072 | 4.144 | 6.216 | 8.288 | 10.36 | 12.43 | 14.50 | 16.58 | 18.65 | 20.72 | 22.79 | 24.86 | 26.93 | 29.01 | 31.08 | 33.15 |
| 10 | 2.125 | 4.250 | 6.375 | 8.500 | 10.63 | 12.75 | 14.88 | 17.00 | 19.13 | 21.25 | 23.38 | 25.50 | 27.63 | 29.75 | 31.88 | 34.00 |
| 10 1/4 | 2.178 | 4.356 | 6.534 | 8.713 | 10.89 | 13.07 | 15.25 | 17.43 | 19.60 | 21.78 | 23.96 | 26.14 | 28.32 | 30.49 | 32.67 | 34.85 |
| 10 1/2 | 2.231 | 4.463 | 6.694 | 8.925 | 11.16 | 13.39 | 15.62 | 17.85 | 20.08 | 22.31 | 24.54 | 26.78 | 29.01 | 31.24 | 33.47 | 35.70 |
| 10 3/4 | 2.284 | 4.569 | 6.853 | 9.138 | 11.42 | 13.71 | 15.99 | 18.28 | 20.56 | 22.84 | 25.13 | 27.41 | 29.70 | 31.98 | 34.27 | 36.55 |
| 11 | 2.338 | 4.675 | 7.013 | 9.350 | 11.69 | 14.03 | 16.36 | 18.70 | 21.04 | 23.38 | 25.71 | 28.05 | 30.39 | 32.73 | 35.06 | 37.40 |
| 11 1/4 | 2.391 | 4.781 | 7.172 | 9.563 | 11.95 | 14.34 | 16.73 | 19.13 | 21.52 | 23.91 | 26.30 | 28.69 | 31.08 | 33.47 | 35.86 | 38.25 |
| 11 1/2 | 2.444 | 4.888 | 7.331 | 9.775 | 12.22 | 14.66 | 17.11 | 19.55 | 21.99 | 24.44 | 26.88 | 29.33 | 31.77 | 34.21 | 36.66 | 39.10 |
| 11 3/4 | 2.497 | 4.994 | 7.491 | 9.988 | 12.48 | 14.98 | 17.48 | 19.98 | 22.47 | 24.97 | 27.47 | 29.96 | 32.46 | 34.96 | 37.45 | 39.95 |
| 12 | 2.550 | 5.100 | 7.650 | 10.20 | 12.75 | 15.30 | 17.85 | 20.40 | 22.95 | 25.50 | 28.05 | 30.60 | 33.15 | 35.70 | 38.25 | 40.80 |
| 12 1/2 | 2.66 | 5.31 | 7.97 | 10 63 | 13.28 | 15.94 | 18.59 | 21.25 | 23.91 | 26.56 | 29.2 | 31.9 | 34.5 | 37.2 | 39.8 | 42.5 |
| 13 | 2.76 | 5.53 | 8.29 | 11.05 | 13.81 | 16.58 | 19.34 | 22.10 | 24.86 | 27.63 | 30.4 | 33.2 | 35.9 | 38.7 | 41.4 | 44.2 |
| 13 1/2 | 2.87 | 5 74 | 8.61 | 11.48 | 14.34 | 17.21 | 20.08 | 22.95 | 25.82 | 28.69 | 31.6 | 34.4 | 37.3 | 40.2 | 43 0 | 45.9 |
| 14 | 2 98 | 5.95 | 8.93 | 11 90 | 14.88 | 17.85 | 20.83 | 23.80 | 26.78 | 29.75 | 32.7 | 35.7 | 38.7 | 41.7 | 44.6 | 47.6 |
| 14 1/2 | 3.08 | 6.16 | 9.24 | 12.33 | 15.41 | 18.49 | 21.57 | 24.65 | 27.73 | 30.81 | 33.9 | 37.0 | 40.1 | 43 1 | 46 2 | 49.3 |
| 15 | 3.19 | 6.38 | 9.56 | 12.75 | 15.94 | 19.13 | 22.31 | 25.50 | 28.69 | 31.88 | 35.1 | 38.3 | 41.4 | 44.6 | 47 8 | 51.0 |
| 15 1/2 | 3.29 | 6.59 | 9.88 | 13.18 | 16.47 | 19.76 | 23.06 | 26.35 | 29.64 | 32.94 | 36.2 | 39.5 | 42.8 | 46 1 | 49.4 | 52.7 |
| 16 | 3.40 | 6.80 | 10.20 | 13.60 | 17.00 | 20.40 | 23.80 | 27.20 | 30.60 | 34.00 | 37.4 | 40.8 | 44.2 | 47 6 | 51.0 | 54.4 |
| 16 1/2 | 3.51 | 7.01 | 10 52 | 14 03 | 17.53 | 21.04 | 24.54 | 28.05 | 31.56 | 35.06 | 38.6 | 42.1 | 45.6 | 49 1 | 52.6 | 56.1 |
| 17 | 3.61 | 7.23 | 10.84 | 14.45 | 18.06 | 21.68 | 25.29 | 28.90 | 32.51 | 36.13 | 39.7 | 43.4 | 47 0 | 50.6 | 54.2 | 57.8 |
| 17 1/2 | 3.72 | 7.44 | 11.16 | 14.88 | 18.59 | 22.31 | 26.03 | 29.75 | 33.47 | 37.19 | 40.9 | 44 6 | 48.3 | 52 1 | 55.8 | 59.5 |
| 18 | 3.83 | 7.65 | 11.48 | 15.30 | 19.13 | 22.95 | 26.78 | 30.60 | 34.43 | 38.25 | 42.1 | 45.9 | 49.7 | 53.6 | 57 4 | 61.2 |
| 18 1/2 | 3.93 | 7.86 | 11.79 | 15.73 | 19.66 | 23.59 | 27.52 | 31.45 | 35.38 | 39.31 | 43.2 | 47.2 | 51.1 | 55.0 | 59 0 | 62.9 |
| 19 | 4.04 | 8.08 | 12.11 | 16.15 | 20.19 | 24.23 | 28.26 | 32.30 | 36.34 | 40.38 | 44.4 | 48.5 | 52.5 | 56.5 | 60.6 | 64 6 |
| 19 1/2 | 4.14 | 8.29 | 12.43 | 16.58 | 20.72 | 24.86 | 29.01 | 33.15 | 37.29 | 41.44 | 45.6 | 49.7 | 53.9 | 58.0 | 62.2 | 66.3 |
| 20 | 4 25 | 8.50 | 12.75 | 17.00 | 21.25 | 25.50 | 29.75 | 34 00 | 38.25 | 42.50 | 46.8 | 51.0 | 55.3 | 59.5 | 63.8 | 68.0 |
| 20 1/2 | 4.36 | 8.71 | 13.07 | 17.43 | 21.78 | 26.14 | 30.49 | 34.85 | 39.21 | 43.56 | 47 9 | 52.3 | 56.6 | 61.0 | 65.3 | 69.7 |
| 21 | 4.46 | 8.93 | 13.39 | 17.85 | 22.31 | 26.78 | 31.24 | 35.70 | 40.16 | 44.63 | 49.1 | 53.6 | 58.0 | 62.5 | 66.9 | 71.4 |
| 21 1/2 | 4.57 | 9.14 | 13.71 | 18.28 | 22.84 | 27.41 | 31.98 | 36.55 | 41.12 | 45.69 | 50.3 | 54.8 | 59.4 | 64.0 | 68.5 | 73.1 |
| 22 | 4.68 | 9.35 | 14.03 | 18.70 | 23.38 | 28.05 | 32.73 | 37.40 | 42.08 | 46.75 | 51.4 | 56.1 | 60.8 | 65.5 | 70.1 | 74.8 |

# WEIGHTS OF FLAT ROLLED STEEL

POUNDS PER LINEAR FOOT

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 22½ | 4.78 | 9.56 | 14.34 | 19.13 | 23.91 | 28.69 | 33.47 | 38.25 | 43.03 | 47.81 | 52.6 | 57.4 | 62.2 | 66.9 | 71.7 | 76.5 |
| 23 | 4.89 | 9.78 | 14.66 | 19.55 | 24.44 | 29.33 | 34.21 | 39.10 | 43.99 | 48.88 | 53.8 | 58.7 | 63.5 | 68.4 | 73.3 | 78.2 |
| 23½ | 4.99 | 9.99 | 14.98 | 19.98 | 24.97 | 29.96 | 34.96 | 39.95 | 44.94 | 49.94 | 54.9 | 59.9 | 64.9 | 69.9 | 74.9 | 79.9 |
| 24 | 5.10 | 10.20 | 15.30 | 20.40 | 25.50 | 30.60 | 35.70 | 40.80 | 45.90 | 51.00 | 56.1 | 61.2 | 66.3 | 71.4 | 76.5 | 81.6 |
| 25 | 5.31 | 10.63 | 15.94 | 21.25 | 26.56 | 31.88 | 37.19 | 42.50 | 47.81 | 53.13 | 58.4 | 63.8 | 69.1 | 74.4 | 79.7 | 85.0 |
| 26 | 5.53 | 11.05 | 16.58 | 22.10 | 27.63 | 33.15 | 38.68 | 44.20 | 49.73 | 55.25 | 60.8 | 66.3 | 71.8 | 77.4 | 82.9 | 88.4 |
| 27 | 5.74 | 11.48 | 17.21 | 22.95 | 28.69 | 34.43 | 40.16 | 45.90 | 51.64 | 57.38 | 63.1 | 68.9 | 74.6 | 80.3 | 86.1 | 91.8 |
| 28 | 5.95 | 11.90 | 17.85 | 23.80 | 29.75 | 35.70 | 41.65 | 47.60 | 53.55 | 59.50 | 65.5 | 71.4 | 77.4 | 83.3 | 89.3 | 95.2 |
| 29 | 6.16 | 12.33 | 18.49 | 24.65 | 30.81 | 36.98 | 43.14 | 49.30 | 55.46 | 61.63 | 67.8 | 74.0 | 80.1 | 86.3 | 92.4 | 98.6 |
| 30 | 6.38 | 12.75 | 19.13 | 25.50 | 31.88 | 38.25 | 44.63 | 51.00 | 57.38 | 63.75 | 70.1 | 76.5 | 82.9 | 89.3 | 95.6 | 102.0 |
| 31 | 6.59 | 13.18 | 19.76 | 26.35 | 32.94 | 39.53 | 46.11 | 52.70 | 59.29 | 65.88 | 72.5 | 79.1 | 85.6 | 92.2 | 98.8 | 105.4 |
| 32 | 6.80 | 13.60 | 20.40 | 27.20 | 34.00 | 40.80 | 47.60 | 54.40 | 61.20 | 68.00 | 74.8 | 81.6 | 88.4 | 95.2 | 102.0 | 108.8 |
| 33 | 7.01 | 14.03 | 21.04 | 28.05 | 35.06 | 42.08 | 49.09 | 56.10 | 63.11 | 70.13 | 77.1 | 84.2 | 91.2 | 98.2 | 105.2 | 112.2 |
| 34 | 7.23 | 14.45 | 21.68 | 28.90 | 36.13 | 43.35 | 50.58 | 57.80 | 65.03 | 72.25 | 79.5 | 86.7 | 93.9 | 101.2 | 108.4 | 115.6 |
| 35 | 7.44 | 14.88 | 22.31 | 29.75 | 37.19 | 44.63 | 52.06 | 59.50 | 66.94 | 74.38 | 81.8 | 89.3 | 96.7 | 104.1 | 111.6 | 119.0 |
| 36 | 7.65 | 15.30 | 22.95 | 30.60 | 38.25 | 45.90 | 53.55 | 61.20 | 68.85 | 76.50 | 84.2 | 91.8 | 99.5 | 107.1 | 114.8 | 122.4 |
| 37 | 7.86 | 15.73 | 23.59 | 31.45 | 39.31 | 47.18 | 55.04 | 62.90 | 70.76 | 78.63 | 86.5 | 94.4 | 102.2 | 110.1 | 117.9 | 125.8 |
| 38 | 8.08 | 16.15 | 24.23 | 32.30 | 40.38 | 48.45 | 56.53 | 64.60 | 72.68 | 80.75 | 88.8 | 96.9 | 105.0 | 113.1 | 121.1 | 129.2 |
| 39 | 8.29 | 16.58 | 24.86 | 33.15 | 41.44 | 49.73 | 58.01 | 66.30 | 74.59 | 82.88 | 91.2 | 99.5 | 107.7 | 116.0 | 124.3 | 132.6 |
| 40 | 8.50 | 17.00 | 25.50 | 34.00 | 42.50 | 51.00 | 59.50 | 68.00 | 76.50 | 85.00 | 93.5 | 102.0 | 110.5 | 119.0 | 127.5 | 136.0 |
| 41 | 8.71 | 17.43 | 26.14 | 34.85 | 43.56 | 52.28 | 60.99 | 69.70 | 78.41 | 87.13 | 95.8 | 104.6 | 113.3 | 122.0 | 130.7 | 139.4 |
| 42 | 8.93 | 17.85 | 26.78 | 35.70 | 44.63 | 53.55 | 62.48 | 71.40 | 80.33 | 89.25 | 98.2 | 107.1 | 116.0 | 125.0 | 133.9 | 142.8 |
| 43 | 9.14 | 18.28 | 27.41 | 36.55 | 45.69 | 54.83 | 63.96 | 73.10 | 82.24 | 91.38 | 100.5 | 109.7 | 118.8 | 127.9 | 137.1 | 146.2 |
| 44 | 9.35 | 18.70 | 28.05 | 37.40 | 46.75 | 56.10 | 65.45 | 74.80 | 84.15 | 93.50 | 102.9 | 112.2 | 121.6 | 130.9 | 140.3 | 149.6 |
| 45 | 9.56 | 19.13 | 28.69 | 38.25 | 47.81 | 57.38 | 66.94 | 76.50 | 86.06 | 95.63 | 105.2 | 114.8 | 124.3 | 133.9 | 143.4 | 153.0 |
| 46 | 9.78 | 19.55 | 29.33 | 39.10 | 48.88 | 58.65 | 68.43 | 78.20 | 87.98 | 97.75 | 107.5 | 117.3 | 127.1 | 136.9 | 146.6 | 156.4 |
| 47 | 9.99 | 19.98 | 29.96 | 39.95 | 49.94 | 59.93 | 69.91 | 79.90 | 89.89 | 99.88 | 109.9 | 119.9 | 129.8 | 139.8 | 149 8 | 159.8 |
| 48 | 10.20 | 20.40 | 30.60 | 40.80 | 51.00 | 61.20 | 71.40 | 81.60 | 91.80 | 102.0 | 112.2 | 122.4 | 132.6 | 142.8 | 153.0 | 163.2 |
| 49 | 10.4 | 20.8 | 31.2 | 41.7 | 52.1 | 62.5 | 72.9 | 83.3 | 93.7 | 104.1 | 114.5 | 125.0 | 135.4 | 145.8 | 156.2 | 166.6 |
| 50 | 10.6 | 21.3 | 31.9 | 42.5 | 53.1 | 63.8 | 74.4 | 85.0 | 95.6 | 106.3 | 116.9 | 127.5 | 138.1 | 148.8 | 159.4 | 170.0 |
| 51 | 10.8 | 21.7 | 32.5 | 43.4 | 54.2 | 65.0 | 75.9 | 86.7 | 97.5 | 108.4 | 119.2 | 130.1 | 140 9 | 151.7 | 162 6 | 173.4 |
| 52 | 11.1 | 22.1 | 33.2 | 44.2 | 55.3 | 66.3 | 77.4 | 88.4 | 99.5 | 110.5 | 121.6 | 132.6 | 143.7 | 154.7 | 165.8 | 176.8 |
| 53 | 11.3 | 22.5 | 33.8 | 45.1 | 56.3 | 67.6 | 78.8 | 90.1 | 101.4 | 112.6 | 123.9 | 135.2 | 146.4 | 157.7 | 168.9 | 180.2 |
| 54 | 11.5 | 23.0 | 34.4 | 45.9 | 57.4 | 68.9 | 80 3 | 91.8 | 103.3 | 114.8 | 126.2 | 137.7 | 149.2 | 160.7 | 172.1 | 183 6 |
| 55 | 11.7 | 23.4 | 35.1 | 46.8 | 58.4 | 70.1 | 81.8 | 93.5 | 105.2 | 116 9 | 128.6 | 140.3 | 151.9 | 163.6 | 175.3 | 187.0 |
| 56 | 11.9 | 23.8 | 35.7 | 47.6 | 59.5 | 71.4 | 83.3 | 95.2 | 107.1 | 119.0 | 130.9 | 142.8 | 154.7 | 166.6 | 178.5 | 190.4 |
| 57 | 12.1 | 24.2 | 36.3 | 48.5 | 60.6 | 72.7 | 84.8 | 96.9 | 109.0 | 121.1 | 133.2 | 145.4 | 157.5 | 169.6 | 181.7 | 193.8 |
| 58 | 12.3 | 24.7 | 37.0 | 49.3 | 61.6 | 74.0 | 86.3 | 98.6 | 110.9 | 123.3 | 135.6 | 147.9 | 160.2 | 172.6 | 184.9 | 197.2 |
| 59 | 12.5 | 25.1 | 37.6 | 50.2 | 62.7 | 75.2 | 87.8 | 100.3 | 112.8 | 125.4 | 137.9 | 150.5 | 163.0 | 175.5 | 188.1 | 200.6 |
| 60 | 12.8 | 25.5 | 38.3 | 51.0 | 63.8 | 76.5 | 89.3 | 102.0 | 114.8 | 127.5 | 140.3 | 153.0 | 165.8 | 178.5 | 191.3 | 204.0 |
| 61 | 13.0 | 25.9 | 38.9 | 51.9 | 64.8 | 77.8 | 90.7 | 103.7 | 116.7 | 129.6 | 142.6 | 155.6 | 168.5 | 181.5 | 194.4 | 207.4 |
| 62 | 13.2 | 26.4 | 39.5 | 52.7 | 65.9 | 79.1 | 92.2 | 105.4 | 118 6 | 131.8 | 144.9 | 158.1 | 171.3 | 184.5 | 197 6 | 210 8 |
| 63 | 13.4 | 26.8 | 40.2 | 53.6 | 66.9 | 80.3 | 93.7 | 107.1 | 120.5 | 133.9 | 147.3 | 160.7 | 174 0 | 187.4 | 200.8 | 214.2 |
| 64 | 13.6 | 27.2 | 40.8 | 54.4 | 68.0 | 81.6 | 95.2 | 108.8 | 122.4 | 136.0 | 149.6 | 163.2 | 176.8 | 190.4 | 204.0 | 217.6 |
| 65 | 13.8 | 27.6 | 41.4 | 55.3 | 69.1 | 82.9 | 96.7 | 110.5 | 124.3 | 138.1 | 151.9 | 165.8 | 179.6 | 193.4 | 207.2 | 221.0 |
| 66 | 14.0 | 28.1 | 42.1 | 56.1 | 70.1 | 84.2 | 98.2 | 112.2 | 126.2 | 140.3 | 154.3 | 168.3 | 182.3 | 196.4 | 210 4 | 224.4 |
| 67 | 14.2 | 28.5 | 42.7 | 57.0 | 71.2 | 85.4 | 99.7 | 113.9 | 128.1 | 142.4 | 156.6 | 170.9 | 185.1 | 199.3 | 213.6 | 227.8 |
| 68 | 14.5 | 28.9 | 43.4 | 57.8 | 72.3 | 86.7 | 101.2 | 115.6 | 130.1 | 144.5 | 159.0 | 173.4 | 187.9 | 202.3 | 216 8 | 231.2 |
| 69 | 14.7 | 29.3 | 44.0 | 58.7 | 73.3 | 88 0 | 102.6 | 117.3 | 132.0 | 146.6 | 161.3 | 176.0 | 190.6 | 205.3 | 219.9 | 234.6 |
| 70 | 14.9 | 29.8 | 44.6 | 59.5 | 74.4 | 89.3 | 104.1 | 119.0 | 133.9 | 148.8 | 163.6 | 178.5 | 193.4 | 208.3 | 223.1 | 238.0 |
| 71 | 15.1 | 30.2 | 45.3 | 60.4 | 75.4 | 90.5 | 105.6 | 120.7 | 135.8 | 150.9 | 166.0 | 181.1 | 196.1 | 211.2 | 226.3 | 241.4 |
| 72 | 15.3 | 30.6 | 45.9 | 61.2 | 76.5 | 91.8 | 107.1 | 122.4 | 137.7 | 153.0 | 168.3 | 183.6 | 198.9 | 214.2 | 229.5 | 244.8 |
| 73 | 15.5 | 31.0 | 46.5 | 62.1 | 77.6 | 93.1 | 108.6 | 124.1 | 139.6 | 155.1 | 170.6 | 186.2 | 201.7 | 217.2 | 232.7 | 248.2 |
| 74 | 15.7 | 31.5 | 47.2 | 62.9 | 78.6 | 94.4 | 110.1 | 125.8 | 141.5 | 157.3 | 173.0 | 188.7 | 204.4 | 220.2 | 235.9 | 251.6 |
| 75 | 15.9 | 31.9 | 47.8 | 63.8 | 79.7 | 95.6 | 111.6 | 127.5 | 143.4 | 159.4 | 175.3 | 191.3 | 207.2 | 223.1 | 239.1 | 255.0 |
| 76 | 16.2 | 32.3 | 48.5 | 64.6 | 80.8 | 96.9 | 113.1 | 129.2 | 145.4 | 161.5 | 177.7 | 193.8 | 210.0 | 226.1 | 242 3 | 258.4 |
| 78 | 16.6 | 33.2 | 49.7 | 66.3 | 82.9 | 99.5 | 116.0 | 132.6 | 149.2 | 165.8 | 182.3 | 198.9 | 215.5 | 232.1 | 248.6 | 265 2 |
| 80 | 17.0 | 34.0 | 51.0 | 68.0 | 85.0 | 102.0 | 119.0 | 136.0 | 153.0 | 170.0 | 187.0 | 204.0 | 221.0 | 238.0 | 255.0 | 272 0 |
| 82 | 17.4 | 34.9 | 52.3 | 69.7 | 87.1 | 104.6 | 122.0 | 139.4 | 156.8 | 174.3 | 191.7 | 209.1 | 226.5 | 244.0 | 261.4 | 278 8 |
| 84 | 17.9 | 35.7 | 53.6 | 71.4 | 89.3 | 107.1 | 125.0 | 142.8 | 160.7 | 178.5 | 196.4 | 214.2 | 232 1 | 249 9 | 267.8 | 285 6 |
| 86 | 18.3 | 36.6 | 54.8 | 73.1 | 91.4 | 109.7 | 127.9 | 146.2 | 164.5 | 182.8 | 201.0 | 219.3 | 237.6 | 255.9 | 274.1 | 292.4 |
| 88 | 18.7 | 37.4 | 56.1 | 74.8 | 93.5 | 112.2 | 130.9 | 149.6 | 168.3 | 187.0 | 205.7 | 224.4 | 243.1 | 261.8 | 280.5 | 299.2 |
| 90 | 19.1 | 38.3 | 57.4 | 76.5 | 95.6 | 114.8 | 133.9 | 153.0 | 172.1 | 191.3 | 210.4 | 229.5 | 248.6 | 267.8 | 286 9 | 306 0 |
| 92 | 19.6 | 39.1 | 58.7 | 78.2 | 97.8 | 117.3 | 136.9 | 156.4 | 176.0 | 195.5 | 215.1 | 234.6 | 254.2 | 273.7 | 293.3 | 312 8 |
| 94 | 20.0 | 40.0 | 59.9 | 79.9 | 99.9 | 119.9 | 139.8 | 159.8 | 179.8 | 199.8 | 219.7 | 239 7 | 259.7 | 279.7 | 299 6 | 319.6 |
| 96 | 20.4 | 40.8 | 61.2 | 81.6 | 102 0 | 122.4 | 142.8 | 163.2 | 183.6 | 204.0 | 224.4 | 244 8 | 265.2 | 285 6 | 306 0 | 326.4 |
| 98 | 20.8 | 41.7 | 62.5 | 83.3 | 104.1 | 125.0 | 145.8 | 166.6 | 187.4 | 208.3 | 229.1 | 249 9 | 270.7 | 291.6 | 312 4 | 333.2 |
| 100 | 21.3 | 42.5 | 63.8 | 85.0 | 106.3 | 127.5 | 148.8 | 170.0 | 191.3 | 212.5 | 233.8 | 255.0 | 276.3 | 297.5 | 318.8 | 340.0 |

# WIRE AND SHEET METAL GAUGES
## IN DECIMALS OF AN INCH

| Number of Gauge | Birmingham or Stubs Iron Wire Gauge (B. W. G.) | American or Brown & Sharpe Wire Gauge. | United States Standard Gauge for Sheet and Plate Iron and Steel. | American Steel & Wire Co. formerly Washburn & Moen John A. Roebling's Sons Co. | Trenton Iron Co. Wire Gauge. | British Imperial or English Legal Standard Wire Gauge. | New Birmingham Standard Sheet and Hoop Gauge (B. G.) |
|---|---|---|---|---|---|---|---|
| 0000000 | .... | ..... | .5 | ..... | ..... | .500 | .6666 |
| 000000 | .... | ..... | .46875 | .4600 | ..... | .464 | .625 |
| 00000 | .... | ..... | .4375 | .4300 | .450 | .432 | .5883 |
| 0000 | .454 | .460000 | .40625 | .3938 | .400 | .400 | .5416 |
| 000 | .425 | .409642 | .375 | .3625 | .360 | .372 | .500 |
| 00 | .380 | .364796 | .34375 | .3310 | .330 | .348 | .4452 |
| 0 | .340 | .324861 | .3125 | .3065 | .305 | .324 | .3964 |
| 1 | .300 | .289297 | .28125 | .2830 | .285 | .300 | .3532 |
| 2 | .284 | .257627 | .265625 | .2625 | .265 | .276 | .3147 |
| 3 | .259 | .229423 | .25 | .2437 | .245 | .252 | .2804 |
| 4 | .238 | .204307 | .234375 | .2253 | .225 | .232 | .250 |
| 5 | .220 | .181940 | .21875 | .2070 | .205 | .212 | .2225 |
| 6 | .203 | .162023 | .203125 | .1920 | .190 | .192 | .1981 |
| 7 | .180 | .144285 | .1875 | .1770 | .175 | .176 | .1764 |
| 8 | .165 | .128490 | .171875 | .1620 | .160 | .160 | .1570 |
| 9 | .148 | .114423 | .15625 | .1483 | .145 | .144 | .1398 |
| 10 | .134 | .101897 | .140625 | .1350 | .130 | .128 | .1250 |
| 11 | .120 | .090742 | .125 | .1205 | .1175 | .116 | .1113 |
| 12 | .109 | .080808 | .109375 | .1055 | .105 | .104 | .0991 |
| 13 | .095 | .071962 | .09375 | .0915 | .0925 | .092 | .0882 |
| 14 | .083 | .064084 | .078125 | .0800 | .0806 | .080 | .0785 |
| 15 | .072 | .057068 | .0703125 | .0720 | .070 | .072 | .0699 |
| 16 | .065 | .050821 | .0625 | .0625 | .061 | .064 | .0625 |
| 17 | .058 | .045257 | .05625 | .0540 | .0525 | .056 | .0556 |
| 18 | .049 | .040303 | .05 | .0475 | .045 | .048 | .0495 |
| 19 | .042 | .035890 | .04375 | .0410 | .040 | .040 | .0440 |
| 20 | .035 | .031961 | .0375 | .0348 | .035 | .036 | .0392 |
| 21 | .032 | .028462 | .034375 | .03175 | .031 | .032 | .0349 |
| 22 | .028 | .025346 | .03125 | .0286 | .028 | .028 | .03125 |
| 23 | .025 | .022572 | .028125 | .0258 | .025 | .024 | .02782 |
| 24 | .022 | .020101 | .025 | .0230 | .0225 | .022 | .02476 |
| 25 | .020 | .017900 | .021875 | .0204 | .020 | .020 | .02204 |
| 26 | .018 | .015941 | .01875 | .0181 | .018 | .018 | .01961 |
| 27 | .016 | .014195 | .0171875 | .0173 | .017 | .0164 | .01745 |
| 28 | .014 | .012641 | .015625 | .0162 | .016 | .0148 | .015625 |
| 29 | .013 | .011257 | .0140625 | .0150 | .015 | .0136 | .0139 |
| 30 | .012 | .010025 | .0125 | .0140 | .014 | .0124 | .0123 |
| 31 | .010 | .008928 | .0109375 | .0132 | .013 | .0116 | .0110 |
| 32 | .009 | .007950 | .01015625 | .0128 | .012 | .0108 | .0098 |
| 33 | .008 | .007080 | .009375 | .0118 | .011 | .0100 | .0087 |
| 34 | .007 | .006305 | .00859375 | .0104 | .010 | .0092 | .0077 |
| 35 | .005 | .005615 | .0078125 | .0095 | .0095 | .0084 | .0069 |
| 36 | .004 | .005000 | .00703125 | .0090 | .009 | .0076 | .0061 |
| 37 | .... | .004453 | .006640625 | .0085 | .0085 | .0068 | .0054 |
| 38 | .... | .003965 | .00625 | .0080 | .008 | .0060 | .0048 |
| 39 | .... | .003531 | ..... | .0075 | .0075 | .0052 | .0043 |
| 40 | .... | .003144 | ..... | .0070 | .007 | .0048 | .00386 |

# SQUARE AND ROUND BARS

## WEIGHTS, AREAS AND CIRCUMFERENCE

## 1/16 TO 15/16

| Thickness or Diameter in Inches | Weight in Pounds | | | | Area in Sq. Inches | | Circumference |
|---|---|---|---|---|---|---|---|
| | Square | | Round | | | | |
| | One Inch Long | One Foot Long | One Inch Long | One Foot Long | Square | Round | |
| 1/16 | .001 | .013 | .001 | .010 | .0039 | .0031 | .1964 |
| 5/64 | .002 | .021 | .001 | .016 | .0061 | .0048 | .2454 |
| 3/32 | .002 | .030 | .002 | .023 | .0088 | .0069 | .2945 |
| 7/64 | .003 | .041 | .003 | .032 | .0120 | .0094 | .3436 |
| 1/8 | .004 | .053 | .004 | .042 | .0156 | .0123 | .3927 |
| 9/64 | .006 | .067 | .004 | .053 | .0198 | .0155 | .4418 |
| 5/32 | .007 | .083 | .005 | .065 | .0244 | .0192 | .4909 |
| 11/64 | .008 | .100 | .007 | .079 | .0295 | .0232 | .5400 |
| 3/16 | .010 | .120 | .008 | .094 | .0352 | .0276 | .5891 |
| 13/64 | .012 | .140 | .009 | .110 | .0413 | .0324 | .6381 |
| 7/32 | .014 | .163 | .011 | 128 | .0479 | .0376 | .6872 |
| 15/64 | .016 | .187 | .012 | .147 | .0549 | .0431 | .7363 |
| 1/4 | .018 | .212 | .014 | .167 | .0625 | .0491 | .7854 |
| 17/64 | .020 | .240 | .016 | .188 | .0706 | .0554 | .8345 |
| 9/32 | .022 | .269 | .018 | .211 | .0791 | .0621 | .8836 |
| 19/64 | .025 | .300 | .020 | .235 | .0881 | .0692 | .9327 |
| 5/16 | .028 | .332 | .022 | .261 | .0977 | .0767 | .9818 |
| 21/64 | .031 | .366 | .024 | .288 | .1077 | .0846 | 1.0308 |
| 11/32 | .033 | .402 | .026 | .316 | .1182 | .0928 | 1.0799 |
| 23/64 | .037 | .439 | .029 | .345 | .1292 | .1014 | 1.1290 |
| 3/8 | .040 | .478 | .031 | .376 | .1406 | .1104 | 1.1781 |
| 25/64 | .043 | .519 | .034 | .407 | .1526 | .1198 | 1.2272 |
| 13/32 | .047 | .561 | .037 | .441 | .1650 | .1296 | 1.2763 |
| 27/64 | .050 | .605 | .040 | .475 | .1780 | .1398 | 1.3254 |
| 7/16 | .054 | .651 | .043 | .511 | .1914 | .1503 | 1.3745 |
| 29/64 | .058 | .698 | .046 | .548 | .2053 | .1613 | 1.4235 |
| 15/32 | .062 | .747 | .049 | .587 | .2197 | .1726 | 1.4726 |
| 31/64 | .066 | .798 | .052 | .627 | .2346 | .1843 | 1.5217 |
| 1/2 | .071 | .850 | .056 | .668 | .2500 | .1963 | 1.5708 |
| 33/64 | .075 | .904 | .060 | .710 | .2659 | .2088 | 1.6199 |
| 17/32 | .080 | .960 | .063 | 754 | .2822 | .2217 | 1.6690 |
| 35/64 | .085 | 1.017 | .067 | .799 | .2991 | .2349 | 1.7181 |
| 9/16 | .090 | 1.076 | .070 | .845 | .3164 | .2485 | 1.7672 |
| 37/64 | .095 | 1.136 | .074 | .893 | .3342 | .2625 | 1.8162 |
| 19/32 | .100 | 1.199 | .078 | .941 | .3525 | .2769 | 1.8653 |
| 39/64 | .105 | 1.263 | .083 | 992 | .3713 | .2916 | 1.9144 |
| 5/8 | .111 | 1.328 | .087 | 1.043 | .3906 | .3068 | 1.9635 |
| 41/64 | .116 | 1.395 | .091 | 1.096 | .4104 | .3223 | 2.0126 |
| 21/32 | .122 | 1.464 | .096 | 1.150 | .4307 | .3382 | 2.0617 |
| 43/64 | .128 | 1.535 | .100 | 1.205 | .4514 | .3545 | 2.1108 |
| 11/16 | 134 | 1.607 | .105 | 1.262 | .4727 | .3712 | 2.1599 |
| 45/64 | .140 | 1.681 | .110 | 1.320 | .4944 | .3883 | 2.2089 |
| 23/32 | .146 | 1.756 | .115 | 1.380 | .5166 | .4057 | 2.2580 |
| 47/64 | .153 | 1.834 | .120 | 1.440 | .5393 | .4236 | 2.3071 |
| 3/4 | .159 | 1.913 | .125 | 1.502 | .5625 | .4418 | 2.3562 |
| 13/16 | .187 | 2.245 | .147 | 1.763 | .6602 | .5185 | 2.5526 |
| 7/8 | .217 | 2.603 | .170 | 2.044 | .7656 | .6013 | 2.7489 |
| 15/16 | .249 | 2.988 | .196 | 2.347 | .8789 | .6903 | 2.9453 |

# 1″ TO 3 15/16 — SQUARE AND ROUND BARS

## WEIGHTS, AREAS AND CIRCUMFERENCE

| Thickness or Diameter in Inches | Weight in Pounds | | | | Area in Sq. Inches | | ○ Circumference |
|---|---|---|---|---|---|---|---|
| | Square ■ | | Round ● | | ▨ | ◍ | |
| | One Inch Long | One Foot Long | One Inch Long | One Foot Long | Square | Round | |
| 1″ | .28 | 3.400 | .22 | 2.670 | 1.0000 | .7854 | 3.1416 |
| 1/16 | .32 | 3.838 | .25 | 3.015 | 1.1289 | .8866 | 3.3380 |
| 1/8 | .36 | 4.303 | .28 | 3.380 | 1.2656 | .9940 | 3.5343 |
| 3/16 | .40 | 4.795 | .31 | 3.766 | 1.4102 | 1.1075 | 3.7306 |
| 1/4 | .44 | 5.313 | .35 | 4.172 | 1.5625 | 1.2272 | 3.9270 |
| 5/16 | .49 | 5.857 | .38 | 4.600 | 1.7227 | 1.3530 | 4.1234 |
| 3/8 | .54 | 6.428 | .42 | 5.049 | 1.8906 | 1.4849 | 4.3197 |
| 7/16 | .58 | 7.026 | .46 | 5.518 | 2.0664 | 1.6230 | 4.5161 |
| 1/2 | .64 | 7.650 | .50 | 6.008 | 2.2500 | 1.7671 | 4.7124 |
| 9/16 | .69 | 8.301 | .54 | 6.519 | 2.4414 | 1.9175 | 4.9088 |
| 5/8 | .75 | 8.978 | .59 | 7.051 | 2.6406 | 2.0739 | 5.1051 |
| 11/16 | .81 | 9.682 | .63 | 7.604 | 2.8477 | 2.2365 | 5.3015 |
| 3/4 | .87 | 10.41 | .68 | 8.178 | 3.0625 | 2.4053 | 5.4978 |
| 13/16 | .94 | 11.17 | .73 | 8.773 | 3.2852 | 2.5802 | 5.6942 |
| 7/8 | 1.00 | 11.95 | .78 | 9.388 | 3.5156 | 2.7612 | 5.8905 |
| 15/16 | 1.06 | 12.76 | .84 | 10.02 | 3.7539 | 2.9483 | 6.0869 |
| 2″ | 1.13 | 13.60 | .89 | 10.68 | 4.0000 | 3.1416 | 6.2832 |
| 1/16 | 1.21 | 14.46 | .95 | 11.36 | 4.2539 | 3.3410 | 6.4796 |
| 1/8 | 1.28 | 15.35 | 1.01 | 12.06 | 4.5156 | 3.5466 | 6.6759 |
| 3/16 | 1.36 | 16.27 | 1.07 | 12.78 | 4.7852 | 3.7583 | 6.8723 |
| 1/4 | 1.43 | 17.21 | 1.13 | 13.52 | 5.0625 | 3.9761 | 7.0686 |
| 5/16 | 1.52 | 18.18 | 1.19 | 14.28 | 5.3477 | 4.2000 | 7.2650 |
| 3/8 | 1.60 | 19.18 | 1.26 | 15.06 | 5.6406 | 4.4301 | 7.4613 |
| 7/16 | 1.68 | 20.20 | 1.32 | 15.87 | 5.9414 | 4.6664 | 7.6577 |
| 1/2 | 1.77 | 21.25 | 1.39 | 16.69 | 6.2500 | 4.9087 | 7.8540 |
| 9/16 | 1.86 | 22.33 | 1.46 | 17.53 | 6.5664 | 5.1573 | 8.0504 |
| 5/8 | 1.95 | 23.43 | 1.54 | 18.40 | 6.8906 | 5.4119 | 8.2467 |
| 11/16 | 2.05 | 24.56 | 1.61 | 19.29 | 7.2227 | 5.6727 | 8.4431 |
| 3/4 | 2.14 | 25.71 | 1.69 | 20.19 | 7.5625 | 5.9396 | 8.6394 |
| 13/16 | 2.24 | 26.90 | 1.76 | 21.12 | 7.9102 | 6.2126 | 8.8358 |
| 7/8 | 2.34 | 28.10 | 1.84 | 22.07 | 8.2656 | 6.4918 | 9.0321 |
| 15/16 | 2.44 | 29.34 | 1.92 | 23.04 | 8.6289 | 6.7771 | 9.2285 |
| 3″ | 2.55 | 30.60 | 2.01 | 24.03 | 9.0000 | 7.0686 | 9.4248 |
| 1/16 | 2.66 | 31.89 | 2.09 | 25.05 | 9.3789 | 7.3662 | 9.6212 |
| 1/8 | 2.77 | 33.20 | 2.18 | 26.08 | 9.7656 | 7.6699 | 9.8175 |
| 3/16 | 2.88 | 34.55 | 2.26 | 27.13 | 10.160 | 7.9798 | 10.014 |
| 1/4 | 2.99 | 35.92 | 2.35 | 28.21 | 10.563 | 8.2958 | 10.210 |
| 5/16 | 3.11 | 37.31 | 2.44 | 29.30 | 10.973 | 8.6179 | 10.407 |
| 3/8 | 3.23 | 38.73 | 2.53 | 30.42 | 11.391 | 8.9462 | 10.603 |
| 7/16 | 3.35 | 40.18 | 2.63 | 31.55 | 11.816 | 9.2806 | 10.799 |
| 1/2 | 3.47 | 41.65 | 2.73 | 32.71 | 12.250 | 9.6211 | 10.996 |
| 9/16 | 3.60 | 43.15 | 2.82 | 33.89 | 12.691 | 9.9678 | 11.192 |
| 5/8 | 3.72 | 44.68 | 2.92 | 35.09 | 13.141 | 10.321 | 11.388 |
| 11/16 | 3.85 | 46.23 | 3.03 | 36.31 | 13.598 | 10.680 | 11.585 |
| 3/4 | 3.98 | 47.82 | 3.13 | 37.55 | 14.063 | 11.045 | 11.781 |
| 13/16 | 4.12 | 49.42 | 3.23 | 38.81 | 14.535 | 11.416 | 11.977 |
| 7/8 | 4.25 | 51.05 | 3.34 | 40.10 | 15.016 | 11.793 | 12.174 |
| 15/16 | 4.39 | 52.71 | 3.45 | 41.40 | 15.504 | 12.177 | 12.370 |

# SQUARE AND ROUND BARS

## WEIGHTS, AREAS AND CIRCUMFERENCE

## 4″ TO 6 15/16

| Thickness or Diameter in Inches | Weight in Pounds | | | | Area in Sq. Inches | | ○ |
|---|---|---|---|---|---|---|---|
| | Square ■ | | Round ● | | ▨ | ◍ | |
| | One Inch Long | One Foot Long | One Inch Long | One Foot Long | Square | Round | Circumference |
| 4″ | 4.53 | 54.40 | 3.57 | 42.73 | 16.000 | 12.566 | 12.566 |
| 1/16 | 4.68 | 56.11 | 3.67 | 44.07 | 16.504 | 12.962 | 12.763 |
| 1/8 | 4.82 | 57.85 | 3.79 | 45.44 | 17.016 | 13.364 | 12.959 |
| 3/16 | 4.97 | 59.62 | 3.90 | 46.83 | 17.535 | 13.772 | 13.155 |
| 1/4 | 5.12 | 61.41 | 4.02 | 48.24 | 18.063 | 14.186 | 13.352 |
| 5/16 | 5.27 | 63.23 | 4.14 | 49.66 | 18.598 | 14.607 | 13.548 |
| 3/8 | 5.42 | 65.08 | 4.26 | 51.11 | 19.141 | 15.033 | 13.745 |
| 7/16 | 5.58 | 66.95 | 4.38 | 52.58 | 19.691 | 15.466 | 13.941 |
| 1/2 | 5.74 | 68.85 | 4.51 | 54.07 | 20.250 | 15.904 | 14.137 |
| 9/16 | 5.90 | 70.78 | 4.63 | 55.59 | 20.816 | 16.349 | 14.334 |
| 5/8 | 6.06 | 72.73 | 4.76 | 57.12 | 21.391 | 16.800 | 14.530 |
| 11/16 | 6.23 | 74.71 | 4.89 | 58.67 | 21.973 | 17.257 | 14.726 |
| 3/4 | 6.39 | 76.71 | 5.02 | 60.25 | 22.563 | 17.721 | 14.923 |
| 13/16 | 6.56 | 78.74 | 5.15 | 61.85 | 23.160 | 18.190 | 15.119 |
| 7/8 | 6.73 | 80.80 | 5.29 | 63.46 | 23.766 | 18.665 | 15.315 |
| 15/16 | 6.91 | 82.89 | 5.42 | 65.10 | 24.379 | 19.147 | 15.512 |
| 5″ | 7.08 | 85.00 | 5.56 | 66.76 | 25.000 | 19.635 | 15.708 |
| 1/16 | 7.26 | 87.14 | 5.70 | 68.44 | 25.629 | 20.129 | 15.904 |
| 1/8 | 7.44 | 89.30 | 5.84 | 70.14 | 26.266 | 20.629 | 16.101 |
| 3/16 | 7.62 | 91.49 | 5.99 | 71.86 | 26.910 | 21.135 | 16.297 |
| 1/4 | 7.81 | 93.71 | 6.13 | 73.60 | 27.563 | 21.648 | 16.493 |
| 5/16 | 8.00 | 95.96 | 6.28 | 75.37 | 28.223 | 22.166 | 16.690 |
| 3/8 | 8.19 | 98.23 | 6.43 | 77.15 | 28.891 | 22.691 | 16.886 |
| 7/16 | 8.38 | 100.5 | 6.58 | 78.95 | 29.566 | 23.221 | 17.082 |
| 1/2 | 8.57 | 102.9 | 6.73 | 80.78 | 30.250 | 23.758 | 17.279 |
| 9/16 | 8.77 | 105.2 | 6.88 | 82.62 | 30.941 | 24.301 | 17.475 |
| 5/8 | 8.96 | 107.6 | 7.04 | 84.49 | 31.641 | 24.851 | 17.672 |
| 11/16 | 9.16 | 110.0 | 7.20 | 86.38 | 32.348 | 25.406 | 17.868 |
| 3/4 | 9.37 | 112.4 | 7.36 | 88.29 | 33.063 | 25.967 | 18.064 |
| 13/16 | 9.57 | 114.9 | 7.52 | 90.22 | 33.785 | 26.535 | 18.261 |
| 7/8 | 9.78 | 117.4 | 7.68 | 92.17 | 34.516 | 27.109 | 18.457 |
| 15/16 | 9.99 | 119.9 | 7.84 | 94.14 | 35.254 | 27.688 | 18.653 |
| 6″ | 10.20 | 122.4 | 8.01 | 96.13 | 36.000 | 28.274 | 18.850 |
| 1/16 | 10.41 | 125.0 | 8.18 | 98.15 | 36.754 | 28.867 | 19.046 |
| 1/8 | 10.63 | 127.6 | 8.35 | 100.2 | 37.516 | 29.465 | 19.242 |
| 3/16 | 10.85 | 130.2 | 8.52 | 102.2 | 38.285 | 30.069 | 19.439 |
| 1/4 | 11.07 | 132.8 | 8.69 | 104.3 | 39.063 | 30.680 | 19.635 |
| 5/16 | 11.29 | 135.5 | 8.87 | 106.4 | 39.848 | 31.296 | 19.831 |
| 3/8 | 11.51 | 138.2 | 9.04 | 108.5 | 40.641 | 31.919 | 20.028 |
| 7/16 | 11.74 | 140.9 | 9.22 | 110.7 | 41.441 | 32.548 | 20.224 |
| 1/2 | 11.97 | 143.7 | 9.40 | 112.8 | 42.250 | 33.183 | 20.420 |
| 9/16 | 12.20 | 146.5 | 9.58 | 115.0 | 43.066 | 33.824 | 20.617 |
| 5/8 | 12.43 | 149.2 | 9.77 | 117.2 | 43.891 | 34.472 | 20.813 |
| 11/16 | 12.67 | 152.1 | 9.95 | 119.4 | 44.723 | 35.125 | 21.009 |
| 3/4 | 12.91 | 154.9 | 10.14 | 121.7 | 45.563 | 35.785 | 21.206 |
| 13/16 | 13.15 | 157.8 | 10.33 | 123.9 | 46.410 | 36.451 | 21.402 |
| 7/8 | 13.39 | 160.7 | 10.52 | 126.2 | 47.266 | 37.122 | 21.599 |
| 15/16 | 13.64 | 163.6 | 10.71 | 128.5 | 48.129 | 37.800 | 21.795 |

# 7″ TO 9 15/16 SQUARE AND ROUND BARS

## WEIGHTS, AREAS AND CIRCUMFERENCE

| Thickness or Diameter in Inches | Weight in Pounds | | | | Area in Sq. Inches | | ○ Circumference |
|---|---|---|---|---|---|---|---|
| | Square ■ | | Round ● | | ▨ | ◍ | |
| | One Inch Long | One Foot Long | One Inch Long | One Foot Long | Square | Round | |
| 7″ | 13.88 | 166.6 | 10.90 | 130.8 | 49.000 | 38.485 | 21.991 |
| 1/16 | 14.13 | 169.6 | 11.10 | 133.2 | 49.879 | 39.175 | 22.188 |
| 1/8 | 14.38 | 172.6 | 11.30 | 135.6 | 50.766 | 39.871 | 22.384 |
| 3/16 | 14.64 | 175.6 | 11.50 | 138.0 | 51.660 | 40.574 | 22.580 |
| 1/4 | 14.89 | 178.7 | 11.70 | 140.4 | 52.563 | 41.283 | 22.777 |
| 5/16 | 15.15 | 181.8 | 11.90 | 142.8 | 53.473 | 41.997 | 22.973 |
| 3/8 | 15.41 | 184.9 | 12.10 | 145.2 | 54.391 | 42 718 | 23.169 |
| 7/16 | 15.67 | 188.1 | 12.31 | 147.7 | 55.316 | 43.446 | 23.366 |
| 1/2 | 15.94 | 191.3 | 12.52 | 150.2 | 56.250 | 44.179 | 23.562 |
| 9/16 | 16.20 | 194.5 | 12.73 | 152.7 | 57.191 | 44.918 | 23.758 |
| 5/8 | 16.47 | 197.7 | 12.94 | 155.3 | 58.141 | 45.664 | 23.955 |
| 11/16 | 16.74 | 200.9 | 13.15 | 157.8 | 59.098 | 46.415 | 24.151 |
| 3/4 | 17.02 | 204.2 | 13.36 | 160.4 | 60.063 | 47.173 | 24.347 |
| 13/16 | 17.29 | 207.5 | 13.58 | 163.0 | 61.035 | 47.937 | 24.544 |
| 7/8 | 17.57 | 210.9 | 13.80 | 165.6 | 62.016 | 48.707 | 24.740 |
| 15/16 | 17.85 | 214.2 | 14.02 | 168.2 | 63.004 | 49.483 | 24.936 |
| 8″ | 18.11 | 217.6 | 14.24 | 170.9 | 64.000 | 50.266 | 25.133 |
| 1/16 | 18.42 | 221.0 | 14.46 | 173.6 | 65.004 | 51.054 | 25.329 |
| 1/8 | 18.70 | 224.5 | 14.69 | 176.3 | 66.016 | 51.849 | 25.526 |
| 3/16 | 18.99 | 227.9 | 14.92 | 179.0 | 67.035 | 52.649 | 25.722 |
| 1/4 | 19.28 | 231.4 | 15.14 | 181.8 | 68.063 | 53.456 | 25.918 |
| 5/16 | 19.58 | 234.9 | 15.38 | 184.5 | 69.098 | 54.269 | 26.115 |
| 3/8 | 19.87 | 238.5 | 15.61 | 187.3 | 70.141 | 55.088 | 26.311 |
| 7/16 | 20.17 | 242.1 | 15.84 | 190.1 | 71.191 | 55.914 | 26.507 |
| 1/2 | 20.47 | 245.7 | 16.08 | 192.9 | 72.250 | 56.745 | 26.704 |
| 9/16 | 20.77 | 249.3 | 16.31 | 195.8 | 73.316 | 57.583 | 26.900 |
| 5/8 | 21.08 | 252.9 | 16.55 | 198.6 | 74.391 | 58.426 | 27.096 |
| 11/16 | 21.38 | 256.6 | 16.79 | 201.5 | 75.473 | 59.276 | 27.293 |
| 3/4 | 21.69 | 260.3 | 17.04 | 204.4 | 76.563 | 60.132 | 27.489 |
| 13/16 | 22.00 | 264.0 | 17.28 | 207.4 | 77.660 | 60.994 | 27.685 |
| 7/8 | 22.31 | 267.8 | 17.53 | 210.3 | 78.766 | 61.863 | 27.882 |
| 15/16 | 22.63 | 271.6 | 17.77 | 213.3 | 79.879 | 62.737 | 28.078 |
| 9″ | 22.95 | 275.4 | 18.02 | 216.3 | 81.000 | 63.617 | 28.274 |
| 1/16 | 23.27 | 279.2 | 18.27 | 219.3 | 82.129 | 64.504 | 28.471 |
| 1/8 | 23.59 | 283.1 | 18.53 | 222.3 | 83.266 | 65.397 | 28.667 |
| 3/16 | 23.91 | 287.0 | 18.78 | 225.4 | 84.410 | 66.296 | 28.863 |
| 1/4 | 24.24 | 290.9 | 19.04 | 228.5 | 85.563 | 67.201 | 29.060 |
| 5/16 | 24.57 | 294.9 | 19.30 | 231.6 | 86.723 | 68.112 | 29.256 |
| 3/8 | 24.90 | 298.8 | 19.56 | 234.7 | 87.891 | 69.029 | 29.453 |
| 7/16 | 25.23 | 302.8 | 19.82 | 237.8 | 89.066 | 69.953 | 29.649 |
| 1/2 | 25.57 | 306.9 | 20.08 | 241.0 | 90.250 | 70.882 | 29.845 |
| 9/16 | 25.91 | 310.9 | 20.35 | 244.2 | 91.441 | 71.818 | 30.042 |
| 5/8 | 26.25 | 315.0 | 20.61 | 247.4 | 92.641 | 72.760 | 30.238 |
| 11/16 | 26.59 | 319.1 | 20.88 | 250.6 | 93.848 | 73.708 | 30.434 |
| 3/4 | 26.93 | 323.2 | 21.15 | 253.8 | 95.063 | 74.662 | 30.631 |
| 13/16 | 27.28 | 327.4 | 21.42 | 257.1 | 96.285 | 75.622 | 30.827 |
| 7/8 | 27.63 | 331.6 | 21.70 | 260.4 | 97.516 | 76.589 | 31.023 |
| 15/16 | 27.98 | 335.8 | 21.97 | 263.7 | 98.754 | 77.561 | 31.220 |

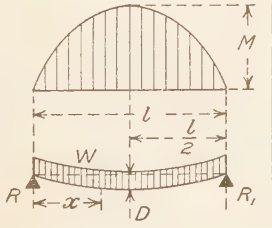
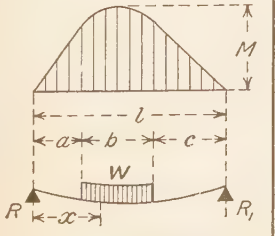
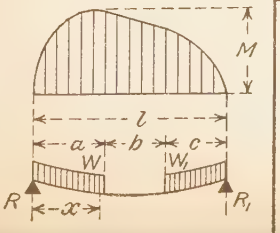
# SQUARE AND ROUND BARS

## WEIGHTS, AREAS AND CIRCUMFERENCE

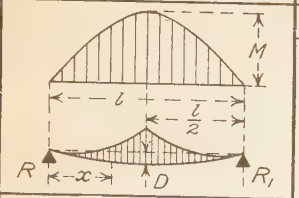
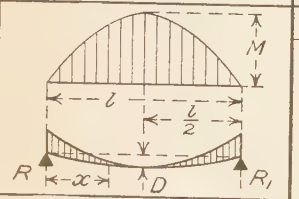
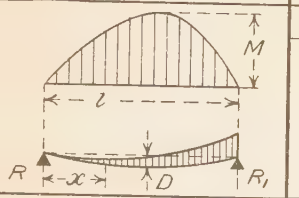
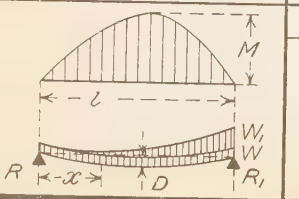
## 10″ TO 15 3/4

| Thickness or Diameter in Inches | Weight in Pounds | | | | Area in Sq. Inches | | Circumference |
|---|---|---|---|---|---|---|---|
| | Square ■ | | Round ● | | ▨ | ◍ | ○ |
| | One Inch Long | One Foot Long | One Inch Long | One Foot Long | Square | Round | |
| 10″ | 28.33 | 340.0 | 22.25 | 267.0 | 100.00 | 78.540 | 31.416 |
| 1/16 | 28.69 | 344.3 | 22.53 | 270.4 | 101.25 | 79.525 | 31.612 |
| 1/8 | 29.04 | 348.6 | 22.81 | 273.8 | 102.52 | 80.516 | 31.809 |
| 3/16 | 29.41 | 352.9 | 23.09 | 277.1 | 103.79 | 81.513 | 32.005 |
| 1/4 | 29.77 | 357.2 | 23.38 | 280.6 | 105.06 | 82.516 | 32.201 |
| 5/16 | 30.13 | 361.6 | 23.66 | 284.0 | 106.35 | 83.525 | 32.398 |
| 3/8 | 30.50 | 366.0 | 23.95 | 287.4 | 107.64 | 84.541 | 32.594 |
| 7/16 | 30.87 | 370.4 | 24.24 | 290.9 | 108.94 | 85.563 | 32.790 |
| 1/2 | 31.24 | 374.9 | 24.53 | 294.4 | 110.25 | 86.590 | 32.987 |
| 9/16 | 31.61 | 379.3 | 24.82 | 297.9 | 111.57 | 87.624 | 33.183 |
| 5/8 | 31.98 | 383.8 | 25.12 | 301.5 | 112.89 | 88.664 | 33.380 |
| 11/16 | 32.36 | 388.4 | 25.42 | 305.0 | 114.22 | 89.710 | 33.576 |
| 3/4 | 32.74 | 392.9 | 25.71 | 308.6 | 115.56 | 90.763 | 33.772 |
| 13/16 | 33.12 | 397.5 | 26.01 | 312.2 | 116.91 | 91.821 | 33.969 |
| 7/8 | 33.51 | 402.1 | 26.32 | 315.8 | 118.27 | 92.886 | 34.165 |
| 15/16 | 33.89 | 406.7 | 26.62 | 319.5 | 119.63 | 93.957 | 34.361 |
| 11″ | 34.28 | 411.4 | 26.92 | 323.1 | 121.00 | 95.033 | 34.558 |
| 1/16 | 34.67 | 416.1 | 27.23 | 326.8 | 122.38 | 96.116 | 34.754 |
| 1/8 | 35.06 | 420.8 | 27.54 | 330.5 | 123.77 | 97.206 | 34.950 |
| 3/16 | 35.46 | 425.5 | 27.85 | 334.3 | 125.16 | 98.301 | 35.147 |
| 1/4 | 35.86 | 430.3 | 28.16 | 338.0 | 126.56 | 99.402 | 35.343 |
| 5/16 | 36.26 | 435.1 | 28.48 | 341.7 | 127.97 | 100.51 | 35.539 |
| 3/8 | 36.66 | 439.9 | 28.79 | 345.5 | 129.39 | 101.62 | 35.736 |
| 7/16 | 37.06 | 444.8 | 29.11 | 349.3 | 130.82 | 102.74 | 35.932 |
| 1/2 | 37.47 | 449.7 | 29.43 | 353.2 | 132.25 | 103.87 | 36.128 |
| 9/16 | 37.88 | 454.6 | 29.75 | 357.0 | 133.69 | 105.00 | 36.325 |
| 5/8 | 38.29 | 459.5 | 30.07 | 360.9 | 135.14 | 106.14 | 36.521 |
| 11/16 | 38.70 | 464.4 | 30.39 | 364.8 | 136.60 | 107.28 | 36.717 |
| 3/4 | 39.12 | 469.4 | 30.72 | 368.7 | 138.06 | 108.43 | 36.914 |
| 13/16 | 39.53 | 474.4 | 31.04 | 372.6 | 139.54 | 109.59 | 37.110 |
| 7/8 | 39.95 | 479.5 | 31.38 | 376.6 | 141.02 | 110.75 | 37.307 |
| 15/16 | 40.37 | 484.5 | 31.71 | 380.5 | 142.50 | 111.92 | 37.503 |
| 12″ | 40.80 | 489.5 | 32.04 | 384.5 | 144.00 | 113.10 | 37.699 |
| 1/4 | 42.52 | 510.1 | 33.39 | 400.7 | 150.06 | 117.86 | 38.485 |
| 1/2 | 44.27 | 531.2 | 34.77 | 417.2 | 156.25 | 122.72 | 39.270 |
| 3/4 | 46.05 | 552.6 | 36.17 | 434.1 | 162.56 | 127.68 | 40.055 |
| 13″ | 47.88 | 574.5 | 37.60 | 451.2 | 169.00 | 132.73 | 40.841 |
| 1/4 | 49.74 | 596.8 | 39.06 | 468.8 | 175.56 | 137.89 | 41.626 |
| 1/2 | 51.63 | 619.6 | 40.55 | 486.6 | 182.25 | 143.14 | 42.412 |
| 3/4 | 53.56 | 642.7 | 42.07 | 504.8 | 189.06 | 148.49 | 43.197 |
| 14″ | 55.53 | 666.3 | 43.62 | 523.3 | 196.00 | 153.94 | 43.982 |
| 1/4 | 57.53 | 690.3 | 45.18 | 542.2 | 203.06 | 159.48 | 44.768 |
| 1/2 | 59.57 | 714.8 | 46.78 | 561.4 | 210.25 | 165.13 | 45.553 |
| 3/4 | 61.64 | 739.6 | 48.41 | 580.9 | 217.56 | 170.87 | 46.339 |
| 15″ | 63.75 | 764.9 | 50.06 | 600.7 | 225.00 | 176.71 | 47.124 |
| 1/4 | 65.89 | 790.6 | 51.75 | 620.9 | 232.56 | 182.65 | 47.909 |
| 1/2 | 68.07 | 816.8 | 53.46 | 641.5 | 240.25 | 188.69 | 48.695 |
| 3/4 | 70.28 | 843.3 | 55.20 | 662.3 | 248.06 | 194.83 | 49.480 |

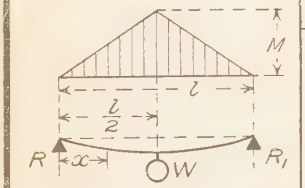
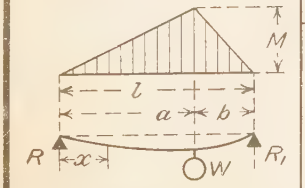
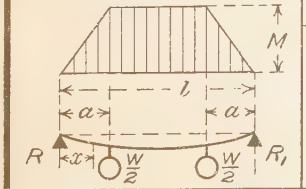
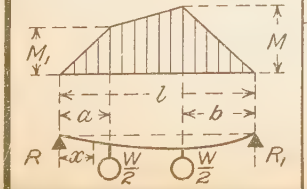
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS R AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
| | **BEAM SUPPORTED BOTH ENDS. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
|  | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2} - \frac{Wx}{l}$ | At *center*<br>$M\,(max) = \frac{Wl}{8}$<br>At $x$<br>$M = \frac{Wx}{2l}\left(l - x\right)$ | At *center*<br>$D\,(max) = \frac{5}{384}\,\frac{Wl^3}{EI}$<br>At $x$<br>$D = \frac{Wx}{24\,EIl}\left(l^3 - 2lx^2 + x^3\right)$ |
| | **BEAM SUPPORTED BOTH ENDS. CONTINUOUS LOAD, PARTIALLY DISTRIBUTED** | | |
|  | $R = \frac{W\,(2c + b)}{2l}$<br>$R_1 = \frac{W\,(2a + b)}{2l}$<br>$V\,(max) = R$ when $a < c$,<br>$= R_1$ when $a > c$<br>At $x$, when $x > a$, or $< (a + b)$<br>$V = \frac{W\,(2c + b)}{2l} - \frac{W}{b}\left(x - a\right)$ | At $x$: when $x = a + \frac{Rb}{W}$<br>$M\,(max) = \frac{W(2c + b)\,[4al + b(2c + b)]}{8\,l^2}$<br>when $x < a$ or $= a$; $M = Rx$<br>when $x < (a+b)$ or $> a$<br>$M = Rx - \frac{W\,(x-a)^2}{2\,b}$<br>when $x > (a + b)$<br>$M = Rx - \frac{W\,(2x - 2a - b)}{2}$ | |
| | **BEAM SUPPORTED BOTH ENDS. TWO CONTINUOUS LOADS, DISTRIBUTED ONE AT EACH END** | | |
|  | $R = \frac{W\,(2\,l - a) + W_1 c}{2l}$<br>$R_1 = \frac{W_1\,(2\,l - c) + Wa}{2l}$<br>$V\,(max) = R$ when $W > W_1$<br>$= R_1$ when $W < W_1$<br>At $x_1$ when $x < a$<br>$V = R - \frac{Wx}{a}$ | At $x$: when $Wa > W_1 c$<br>when $x = \frac{2\,Wal - Wa^2 + W_1\,ca}{2\,Wl}$<br>$M\,(max) = \frac{R^2 a}{2\,W}$<br>when $x < a$ $M = Rx - \frac{Wx^2}{2\,a}$<br>when $x > a$ $M = Rx - \frac{W\,(2\,x - a)}{2}$ | |

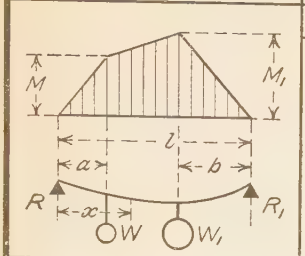
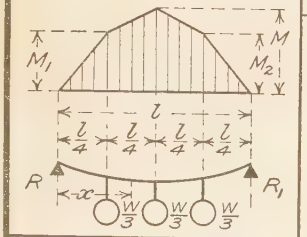
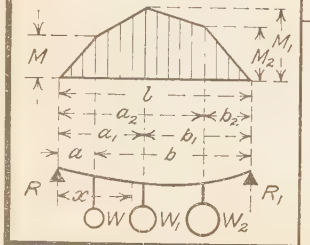
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM SUPPORTED BOTH ENDS. CONTINUOUS LOAD, INCREASING UNIFORMLY TO CENTER** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V_x = \frac{W}{2} - \frac{2\,Wx^2}{l^2}$ | At *center*<br>$M\,(max) = \frac{Wl}{6}$<br>At $x$<br>$M = Wx\left(\frac{1}{2} - \frac{2x^2}{3\,l^2}\right)$ | At *center*<br>$D\,(max) = \frac{Wl^3}{60\,EI}$<br>At $x$<br>$D = \frac{Wx}{6\,EIl^2}\left(\frac{l^2x^2}{2} - \frac{x^4}{5} - \frac{5\,l^4}{16}\right)$ |
|  | **BEAM SUPPORTED BOTH ENDS. CONTINUOUS LOAD, DECREASING UNIFORMLY TO CENTER** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2\,l^2}\left(l - 2x\right)^2$ | At *center*<br>$M\,(max) = \frac{Wl}{12}$<br>At $x$<br>$M = Wx\left(\frac{1}{2} - \frac{x}{l} + \frac{2x^2}{3\,l^2}\right)$ | At *center*<br>$D\,(max) = \frac{3\,Wl^3}{320\,EI}$ |
|  | **BEAM SUPPORTED BOTH ENDS. CONTINUOUS LOAD, INCREASING UNIFORMLY TO ONE END** | | |
| | $R = \frac{W}{3}$<br>$R_1 = V\,(max) = \frac{2\,W}{3}$<br>At $x$<br>$V = \frac{W}{3} - \frac{Wx^2}{l^2}$ | At $x$: when $x = \frac{l\sqrt{3}}{3}$<br>$M\,(max) = \frac{2\,Wl}{9\sqrt{3}} = .128\,Wl$<br>At $x$<br>$M = \frac{Wx}{3}\left(1 - \frac{x^2}{l^2}\right)$ | At $x$: when $x = l\sqrt{1 - \sqrt{\frac{8}{15}}} = .519\,l$<br>$D\,(max) = \frac{.013044\,Wl^3}{EI}$<br>At $x$<br>$D = \frac{Wx}{6\,EIl^2}\left(\frac{x^4}{10} - \frac{l^2x^2}{3} + \frac{7\,l^4}{30}\right)$ |
|  | **BEAM SUPPORTED BOTH ENDS. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED, PLUS LOAD INCREASING UNIFORMLY TO ONE END** | | |
| | $R = \frac{W}{2} + \frac{W_1}{3}$<br>$R_1 = V\,(max) = \frac{W}{2} + \frac{2\,W_1}{3}$<br>At $x$<br>$V = \frac{W}{2} - \frac{Wx}{l} + \frac{W_1}{3} - \frac{W_1x^2}{3\,l^2}$ | At $x$: when $x = 0.5\,l$ to $0.577\,l$<br>$M\,(max) = \left(W + W_1\right)\frac{l}{8}$ *approx.*<br>At $x$<br>$M = \frac{Wx}{2\,l}\left(l - x\right) + \frac{W_1x}{3\,l^2}\left(l^2 - x^2\right)$ | At $x$: when $x = .5\,l$ *approx.*<br>$D\,(max) = \frac{5\,Wl^3}{384\,EI} + \frac{.013044\,Wl^3}{EI}$ |

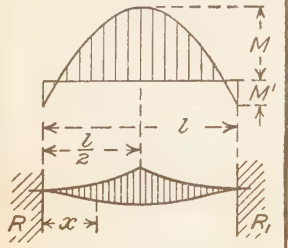
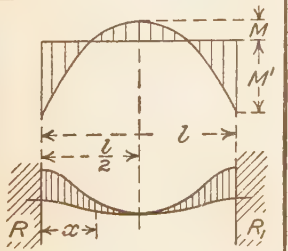
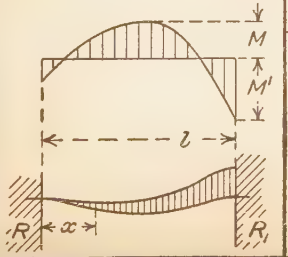
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM SUPPORTED BOTH ENDS. CONCENTRATED LOAD AT CENTER** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2}$ | At *center*<br>$M\,(max) = \frac{Wl}{4}$<br>At $x$<br>$M = \frac{Wx}{2}$ | At *center*<br>$D\,(max) = \frac{Wl^3}{48\,EI}$<br>When $x < \frac{l}{2}$<br>At $x$<br>$D = \frac{W}{48\,EI}\left(3\,l^2x - 4x^3\right)$ |
|  | **BEAM SUPPORTED BOTH ENDS. CONCENTRATED LOAD NEAR ONE END** | | |
| | $R = \frac{Wb}{l}$<br>$R_1 = \frac{Wa}{l}$<br>$V\,(max) = R$ when $a < b$ and $R_1$ when $a > b$<br>At $x$<br>$V = \frac{Wb}{l}$ | At *point of load*<br>$M\,(max) = \frac{Wab}{l}$<br>At $x$: when $x < a$<br>$M = \frac{Wbx}{l}$ | At $x$: when $x = \sqrt{a\,(a+2b) \div 3}$ and $a > b$<br>$D\,(max) = Wab\,(a+2b)\sqrt{3a\,(a+2b)} \div 27\,EIl$<br>At $x$: when $x < a$<br>$D = \frac{Wbx}{6\,EIl}\left[2\,l\,(l-x) - b^2 - (l-x)^2\right]$<br>At $x$: when $x > a$<br>$D = \frac{Wa\,(l-x)}{6EIl}\left[2\,lb - b^2 - (l-x)^2\right]$ |
|  | **BEAM SUPPORTED BOTH ENDS. TWO EQUAL CONCENTRATED LOADS, SYMMETRICALLY DISTRIBUTED** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$: when $x < a$<br>$V = \frac{W}{2}$<br>At $x$: when $x > a$ and $< (l-a)$<br>$V = 0$ | At and between *loads*<br>$M\,(max) = \frac{Wa}{2}$<br>At $x$<br>$M = \frac{Wx}{2}$ | At *center*<br>$D\,(max) = \frac{Wa}{12\,EI}\left(\frac{3\,l^2}{4} - a^2\right)$<br>At $x$: when $x < a$<br>$D = \frac{Wx}{12\,EI}\left(3\,la - 3\,a^2 - x^2\right)$<br>At $x$: when $x > a$ and $< (l-a)$<br>$D = \frac{Wa}{12\,EI}\left(3\,lx - 3\,x^2 - a^2\right)$ |
|  | **BEAM SUPPORTED BOTH ENDS. TWO EQUAL CONCENTRATED LOADS, UNEQUALLY DISTRIBUTED** | | |
| | When $a < b$<br>$R = V\,(max) = \frac{W}{2\,l}\left(l - a + b\right)$<br>$R_1 = \frac{W}{2\,l}\left(l - b + a\right)$<br>$V\,(max) = R$ when $a < b$<br>$= R_1$ when $a > b$ | At $x$: when $x = l - b$ when $b > a$<br>$M\,(max) = \frac{Wb}{2\,l}\left(l + a - b\right)$<br>At $x$: when $x = a$<br>$M = \frac{Wa}{2\,l}\left(l - a + b\right)$<br>At $x$: when $x > a$ or $< (l-b)$<br>$M = Rx - \frac{W}{2}\left(x - a\right)$ | |

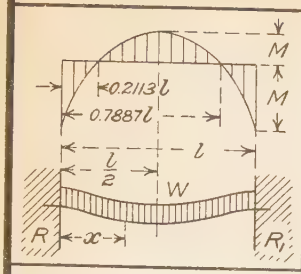
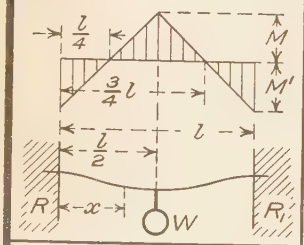
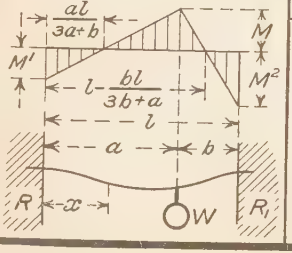
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM SUPPORTED BOTH ENDS. TWO UNEQUAL CONCENTRATED LOADS, UNEQUALLY DISTRIBUTED** | | |
| | $R = \frac{1}{l}\left[W(l-a) + W_1 b\right]$<br>$R_1 = \frac{1}{l}\left[Wa + W_1(l-b)\right]$<br>$V\ (max) =$ *Maximum Reaction*<br>At $x$: when $x > a$ and $< (l-b)$<br>$V = R - W$ | At point of load $W$<br>$M = \frac{a}{l}\left[W(l-a) + W_1 b\right]$<br>At point of load $W_1$<br>$M_1 = \frac{b}{l}\left[Wa + W_1(l-b)\right]$<br>At $x$: when $x > a$ or $< (l-b)$<br>$M = W\frac{a}{l}(l-x) + W_1\frac{bx}{l}$ | |
|  | **BEAM SUPPORTED BOTH ENDS. THREE EQUAL CONCENTRATED LOADS, SYMMETRICALLY DISTRIBUTED** | | |
| | $R = R_1 = V\ (max) = \frac{W}{2}$<br>At $x$: when $x < \frac{l}{4}$<br>$V = \frac{W}{2}$<br>At $x$: when $x > \frac{l}{4}$ and $< \frac{l}{2}$<br>$V = \frac{W}{6}$ | At *center*<br>$M\ (max) = \frac{Wl}{8}$<br>At $x$: when $x = \frac{l}{4}$<br>$M_1 = \frac{Wl}{8}$ | At *center*<br>$D\ (max) = \frac{19}{384}\frac{Wl^3}{3\,EI}$ |
|  | **BEAM SUPPORTED BOTH ENDS. THREE UNEQUAL CONCENTRATED LOADS, UNEQUALLY DISTRIBUTED** | | |
| | $R = \frac{Wb + W_1 b_1 + W_2 b_2}{l}$<br>$R_1 = \frac{Wa + W_1 a_1 + W_2 a_2}{l}$<br>$V\ (max) =$ *Maximum Reaction*<br>At $x$: when $x > a$ and $< a_1$<br>$V = R - W$<br>At $x$: when $x > a_1$ and $< a_2$<br>$V = R - W - W_1$ | At $x$: when $x = a$<br>$M = Ra$<br>At $x$: when $x = a_1$<br>$M_1 = Ra_1 - W(a_1 - a)$<br>At $x$: when $x = a_2$<br>$M_2 = Ra_2 - W(a_2 - a) - W_1(a_2 - a_1)$<br>$M\ (max) = M$ when $W = R$ or $> R$<br>$M\ (max) = M_1$ when $\begin{cases} W_1 + W = R & \text{or} > R \\ W_1 + W_2 = R_1 & \text{or} > R_1 \end{cases}$<br>$M\ (max) = M_2$ when $W_2 = R_1$ or $> R_1$ | |

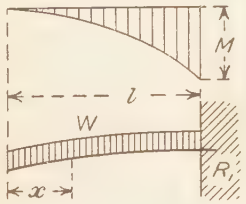
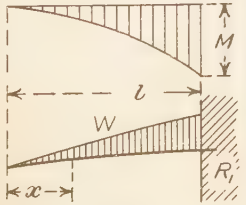
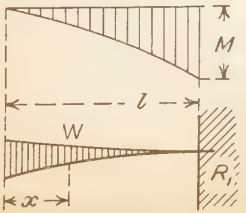
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM FIXED AT BOTH ENDS. CONTINUOUS LOAD, INCREASING UNIFORMLY TO CENTER** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2} - \frac{2\,Wx^2}{l^2}$ | At *center*<br>$M\,(max) = \frac{Wl}{16}$<br>At *support*<br>$M^1\,(max) = \frac{5\,Wl}{48}$<br>At $x$<br>$M = M^1 + \frac{Wx}{2} - \frac{2\,Wx^3}{3\,l^2}$ | |
|  | **BEAM FIXED AT BOTH ENDS. CONTINUOUS LOAD, DECREASING UNIFORMLY TO CENTER** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2\,l^2}\left(l - 2x\right)^2$ | At *center*<br>$M\,(max) = \frac{Wl}{48}$<br>At *support*<br>$M^1\,(max) = \frac{Wl}{16}$ | |
|  | **BEAM FIXED AT BOTH ENDS. CONTINUOUS LOAD, INCREASING UNIFORMLY TO ONE END** | | |
| | $R = \frac{3\,W}{10}$<br>$R_1 = V\,(max) = \frac{7\,W}{10}$<br>At $x$<br>$V = \frac{3\,W}{10} - \frac{W\,x^2}{l^2}$ | At $x$: when $x = .548\,l$<br>$M\,(max) = .043\,Wl$<br>At *support*<br>$M^1 = \frac{Wl}{10}$<br>At $x$<br>$M = \frac{3\,Wx}{10} - \frac{Wl}{15} - \frac{Wx^3}{3\,l^2}$ | |

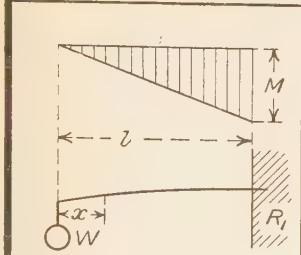
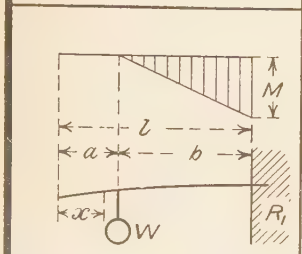
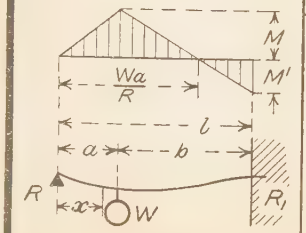
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM FIXED AT BOTH ENDS. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2} - \frac{Wx}{l}$ | At *center*<br>$M\,(max) = \frac{Wl}{24}$<br>At *supports*<br>$M^1\,(max) = \frac{Wl}{12}$<br>At $x$<br>$M = \frac{W}{2l}\left(-\frac{l^2}{6} + lx - x^2\right)$ | At *center*<br>$D\,(max) = \frac{1}{384}\,\frac{Wl^3}{EI}$<br>At $x$<br>$D = \frac{Wx^2}{24\,EIl}\left(l^2 - 2\,lx + x^2\right)$ |
|  | **BEAM FIXED AT BOTH ENDS. CONCENTRATED LOAD, AT CENTER** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$<br>$V = \frac{W}{2}$ | At *center*<br>$M\,(max) = \frac{Wl}{8}$<br>At *supports*<br>$M^1\,(max) = \frac{Wl}{8}$<br>At $x$: when $x < \frac{l}{2}$<br>$M = \frac{W}{2}\left(x - \frac{l}{4}\right)$ | At *center*<br>$D\,(max) = \frac{1}{192}\,\frac{Wl^3}{EI}$<br>At $x$<br>$D = \frac{Wx^2}{6\,EI}\left(-\frac{1}{2}\,x + \frac{3}{8}\,l\right)$ |
|  | **BEAM FIXED AT BOTH ENDS. CONCENTRATED LOAD, NEAR ONE END** | | |
| | $R = W\left(\frac{b^2\,(3\,a + b)}{l^3}\right)$<br>$R_1 = W\left(\frac{a^2\,(3\,b + a)}{l^3}\right)$<br>$V\,(max) = R$ when $a < b$<br>$= R_1$ when $a > b$<br>At $x$: when $x < a$<br>$V = R$ | At *support R*<br>$M^1\left(\begin{matrix}max.\ neg.\ mom.\\ when\ b > a\end{matrix}\right) = -W\,\frac{ab^2}{l^2}$<br>At *support* $R_1$<br>$M^2\left(\begin{matrix}max.\ neg.\ mom.\\ when\ a > b\end{matrix}\right) = -W\,\frac{a^2b}{l^2}$<br>At point of load<br>$M\,(max) = Ra + M^1 = Ra - W\,\frac{ab^2}{l^2}$<br>At $x$<br>$M = Rx - W\,\frac{ab^2}{l^2}$ | At $x$: when $x = \frac{2\,al}{3\,a + b}$ and $a > b$<br>$D\,(max) = \frac{2\,W\,a^3b^2}{3\,EI\,(3\,a + b)^2}$<br>when $x < a$<br>$D = \frac{Wb^2x^2}{6\,EIl^3}\left(3al - 3ax - bx\right)$ |

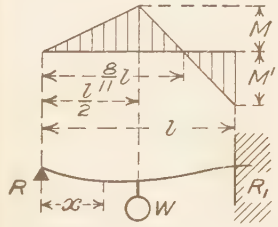
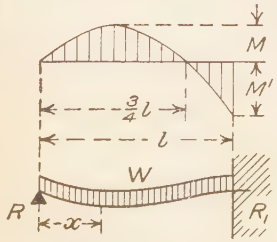
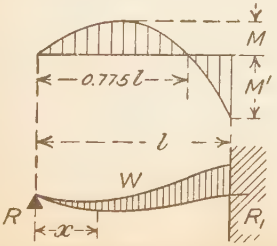
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
| | **BEAM FIXED AT ONE END (CANTILEVER). CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
|   | $R_1 = V\,(max) = W$<br>At $x$<br>$V = \frac{W x}{l}$ | At *fixed end*<br>$M\,(max) = \frac{Wl}{2}$<br>At $x$<br>$M = \frac{Wx^2}{2l}$ | At *free end*<br>$D\,(max) = \frac{Wl^3}{8\,EI}$<br>At $x$<br>$D = \frac{W}{24\,EIl}\left(x^4 - 4\,l^3x + 3\,l^4\right)$ |
| | **BEAM FIXED AT ONE END (CANTILEVER). CONTINUOUS LOAD, INCREASING UNIFORMLY TO FIXED END** | | |
|   | $R_1 = V\,(max) = W$<br>At $x$<br>$V = \frac{W x^2}{l^2}$ | At *fixed end*<br>$M\,(max) = \frac{Wl}{3}$<br>At $x$<br>$M = \frac{Wx^3}{3\,l^2}$ | At *free end*<br>$D\,(max) = \frac{Wl^3}{15\,EI}$<br>At $x$<br>$D = \frac{W}{60EIl^2}\left(x^5 - 5\,l^4x + 4\,l^5\right)$ |
| | **BEAM FIXED AT ONE END (CANTILEVER). CONTINUOUS LOAD, INCREASING UNIFORMLY TO FREE END** | | |
|   | $R_1 = V\,(max) = W$<br>At $x$<br>$V = \frac{W x}{l^2}\left(2\,l - x\right)$ | At *fixed end*<br>$M\,(max) = \frac{2\,Wl}{3}$<br>At $x$<br>$M = \frac{Wx^2}{3\,l^2}\left(3\,l - x\right)$ | At *free end*<br>$D\,(max) = \frac{11\,Wl^3}{60\,EI}$ |

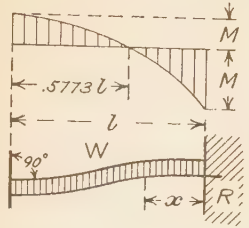
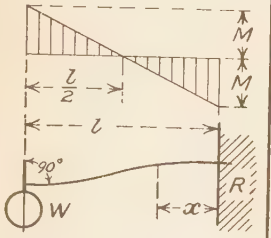
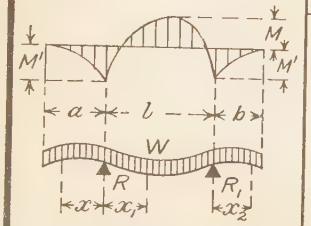
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM FIXED AT ONE END (CANTILEVER). CONCENTRATED LOAD AT FREE END** | | |
| | $R_1 = V\,(max) = W$<br>At $x$<br>$V = W$ | At *fixed end*<br>$M\,(max) = Wl$<br>At $x$<br>$M = Wx$ | At *free end*<br>$D\,(max) = \frac{Wl^3}{3\,EI}$<br>At $x$<br>$D = \frac{W}{6\,EI}\left(2\,l^3 - 3\,l^2x + x^3\right)$ |
|  | **BEAM FIXED AT ONE END (CANTILEVER). CONCENTRATED LOAD AT ANY POINT** | | |
| | $R_1 = V\,(max) = W$<br>At $x$: when $x > a$<br>$V = W$<br>At $x$: when $x < a$<br>$V = 0$ | At *fixed end*<br>$M\,(max) = Wb$<br>At $x$: when $x > a$<br>$M = W\,(x - a)$ | At *free end*<br>$D\,(max) = \frac{Wl^3}{6\,EI}\left[2 - \frac{3\,a}{l} + \left(\frac{a}{l}\right)^3\right]$<br>At *point of load*<br>$D = \frac{W}{3\,EI}\left(l - a\right)^3$<br>At $x$: when $x > a$<br>$D = \frac{W}{6\,EI}\left(-3\,al^2 + 2\,l^3 + x^3 - 3\,ax^2 - 3\,l^2x + 6\,alx\right)$ |
|  | **BEAM FIXED AT ONE END, SUPPORTED AT OTHER. CONCENTRATED LOAD AT ANY POINT** | | |
| | $R = W\left(\frac{3\,b^2l - b^3}{2\,l^3}\right)$<br>$R_1 = W\left(\frac{3\,al^2 - a^3}{2\,l^3}\right)$<br>At $x$ when $x < a$<br>$V = R$<br>At $x$ when $x > a$<br>$V = R - W$ | At *point of load*<br>$M\,(max) = Wa\left(\frac{3b^2l - b^3}{2\,l^3}\right)$<br>At *fixed end*<br>$M^1\,(max) = Wl\left(\frac{3b^2l - b^3}{2\,l^3}\right) - W(l - a)$<br>At $x$: when $x < a$<br>$M = Wx\left(\frac{3b^2l - b^3}{2\,l^3}\right)$<br>At $x$: when $x > a$<br>$M = Wx\left(\frac{3b^2l - b^3}{2\,l^3}\right) - W\,(x - a)$ | At $x$: when $x = a = .414\,l$<br>$D\,(max) = .0098\,\frac{Wl^3}{EI}$<br>At $x$: when $x < a$<br>$D = \frac{1}{6\,EI}\left[3\,Rl^2x - Rx^3 - 3\,W\,(l - a)^2\,x\right]$<br>At $x$: when $x > a$<br>$D = \frac{1}{6\,EI}\left[R_1\,(2\,l^3 - 3\,l^2x + x^3) - 3\,Wa\,(l - x)^2\right]$ |

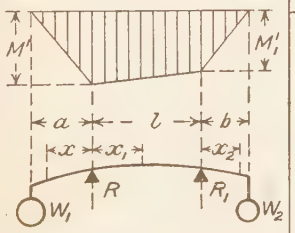
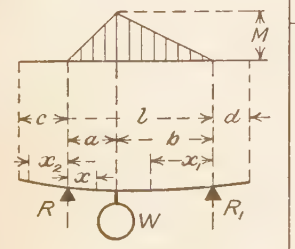
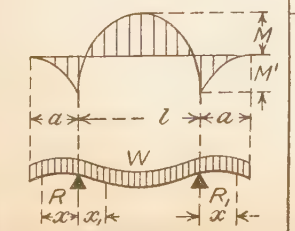
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
| | **BEAM FIXED AT ONE END, SUPPORTED AT OTHER. CONCENTRATED LOAD, AT CENTER** | | |
|  | $R = \frac{5}{16} W$<br>$R_1 = V\,(max) = \frac{11}{16} W$ | At *center*<br>$M\,(max) = \frac{5}{32} Wl$<br>At *fixed end*<br>$M^1\,(max) = \frac{3}{16} Wl$<br>At $x$: when $x < l/2$<br>$M = \frac{5}{16} Wx$<br>At $x$: when $x > l/2$<br>$M = \frac{1}{2} Wl - \frac{11}{16} Wx$ | At $x$: when $x = .4472\,l$<br>$D\,(max) = .00932 \frac{Wl^3}{EI}$<br>At $x$: when $x < l/2$<br>$D = \frac{Wx}{96\,EI}\left(5x^2 - 3\,l^2\right)$<br>At $x$: when $x > l/2$<br>$D = \frac{W}{96\,EI}\left[-2\,l^3 + 15\,l^2x - 24\,lx^2 + 11x^3\right]$ |
| | **BEAM FIXED AT ONE END, SUPPORTED AT OTHER. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
|  | $R = \frac{3}{8} W$<br>$R_1 = V\,(max) = \frac{5}{8} W$<br>At $x$<br>$V = \frac{3}{8} W - \frac{Wx}{l}$ | At $x$: when $x = \frac{3}{8} l$<br>$M\,(max) = \frac{9}{128} Wl$<br>At *fixed end*<br>$M^1\,(max) = \frac{1}{8} Wl$<br>At $x$<br>$M = \frac{Wx}{l}\left(\frac{3}{8} l - \frac{1}{2} x\right)$ | At $x$: when $x = .4215\,l$<br>$D\,(max) = .0054 \frac{Wl^3}{EI}$<br>At $x$<br>$D = \frac{Wx}{48\,EIl}\left[-3\,lx^2 + 2x^3 + l^3\right]$ |
| | **BEAM FIXED AT ONE END, SUPPORTED AT OTHER. CONTINUOUS LOAD, INCREASING UNIFORMLY TO FIXED END** | | |
|  | $R = \frac{1}{5} W$<br>$R_1 = V\,(max) = \frac{4}{5} W$<br>At $x$<br>$V = \frac{W}{5} - \frac{Wx^2}{l^2}$ | At $x$: when $x = .4474\,l$<br>$M\,(max) = .06\,Wl$<br>At *fixed end*<br>$M^1\,(max) = \frac{2\,Wl}{15} = .1333\,Wl$<br>At $x$<br>$M = \frac{Wx}{5} - \frac{Wx^3}{3\,l^2}$ | |

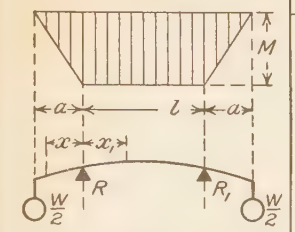
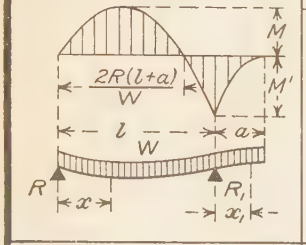
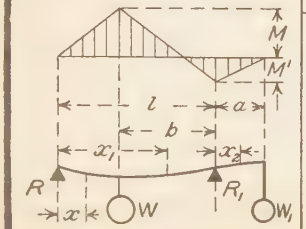
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|   | **BEAM FIXED AT ONE END, FREE BUT GUIDED AT OTHER. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
| | $R = V\,(max) = W$ | At *fixed end* $M\,(max) = \frac{Wl}{3}$ | At *free end* $D\,(max) = \frac{Wl^3}{24\,EI}$ |
| | At $x$ $V = \frac{W(l-x)}{l}$ | At *free end* $M^1 = \frac{Wl}{6}$ | At $x$ $D = \frac{Wx^2}{24\,EIl}\left(2l - x\right)^2$ |
|   | **BEAM FIXED AT ONE END, FREE BUT GUIDED AT OTHER. CONCENTRATED LOAD, AT GUIDED END** | | |
| | $R = V\,(max) = W$ | At *fixed end* $M\,(max) = \frac{Wl}{2}$ | At *free end* $D\,(max) = \frac{Wl^3}{12\,EI}$ |
| | At $x$ $V = W$ | At *free end* $M^1 = \frac{Wl}{2}$ | At $x$ $D = \frac{Wx^2}{12\,EI}\left(3l - 2x\right)$ |
|   | **BEAM OVERHANGING BOTH SUPPORTS, UNSYMMETRICALLY PLACED. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
| | $\frac{W}{a+l+b} = w$ = *load per unit of length* | At $x_1$: when $x_1 = \frac{R}{w} - a$ | |
| | $R = w\left[(a+l)^2 - b^2\right] \div 2l$ | At $R$ $M\,(max) = R\left(\frac{R}{2w} - a\right)$ | |
| | $R_1 = w\left[(b+l)^2 - a^2\right] \div 2l$ | At $R_1$ $M^1 = \frac{1}{2}\,wa^2$ | |
| | $V\,(max) = wa$ or $R - wa$ | $M^1 = \frac{1}{2}\,wb^2$ | |
| | At $x$: when $x < a$ $V = w(a - x)$ | At $x$: when $x < a$ $M = \frac{1}{2}\,w(a-x)^2$ | |
| | At $x_1$: when $x_1 < l$ $V = R - w(a + x_1)$ | At $x_1$: when $x_1 < l$ $M = \frac{1}{2}\,w(a+x_1)^2 - Rx_1$ | |
| | At $x_2$: when $x_2 < b$ $V = w(b - x_2)$ | At $x_2$: when $x_2 < b$ $M = \frac{1}{2}\,w(b-x_2)^2$ | |

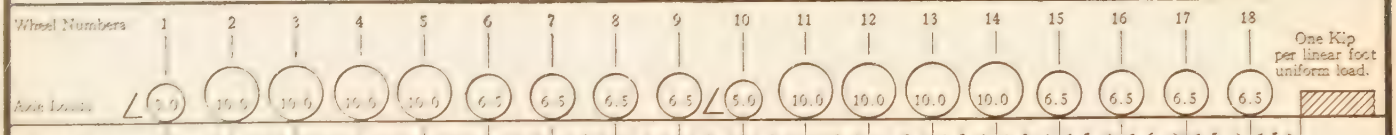
# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM OVERHANGING BOTH SUPPORTS, UNSYMMETRICALLY PLACED. TWO CONCENTRATED LOADS AT ENDS** | | |
| | $R = \frac{W_1 a - W_2 b}{l} + W_1$<br>$R_1 = \frac{W_2 b - W_1 a}{l} + W_2$<br>At $x$: when $x < a$ $V = W_1$<br>At $x_1$: when $x_1 < l$ $V = W_1 - R$<br>At $x_2$: when $x_2 < b$ $V = W_2$ | At $R$<br>At $R_1$ $M = W_1 a$<br>$M = W_2 b$<br>At $x$: when $x < a$<br>$M = W_1 (a - x)$<br>At $x_1$: when $x_1 < l$<br>$M = W_1 a + (W_1 - R) x_1$<br>At $x_2$: when $x_2 < b$<br>$M = W_2 (b - x_2)$ | |
|  | **BEAM OVERHANGING BOTH SUPPORTS, UNSYMMETRICALLY PLACED. CONCENTRATED LOAD AT ANY POINT** | | |
| | $R = \frac{W b}{l}$<br>$R_1 = \frac{W a}{l}$<br>$V\ (max) = R$ when $a < b$<br>At $x$: when $x < a$<br>$V = R$<br>At $x_1$: when $x_1 < b$<br>$V = R_1$ | At *point of load*<br>$M\ (max) = \frac{Wab}{l}$<br>At $x$: when $x < a$<br>$M = \frac{Wbx}{l}$<br>At $x_1$: when $x_1 < b$<br>$M = \frac{Wb}{l}\left(l - x_1\right) - W(b - x_1)$ | At $x_1$: when $x_1 = b\sqrt{\frac{1}{3} + \frac{2a}{3b}}$<br>$D\ (max) = \frac{Wax_1{}^3}{3\ EIl}$<br>At $x_2$: when $x_2 = c$<br>$D = \frac{Wabc}{6\ EIl}\left(l + b\right)$<br>At $x_1$: when $x_1 = d$<br>$D = \frac{Wabd}{6\ EIl}\left(l + a\right)$ |
|  | **BEAM OVERHANGING BOTH SUPPORTS, SYMMETRICALLY PLACED. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
| | $R = R_1 = \frac{W}{2}$<br>$V\ (max) = \frac{Wa}{l + 2a}$ or $\frac{Wl}{2\ (l + 2a)}$ | At *center* $M = \frac{W\ (l - 2a)}{8}$<br>At *supports* $M^1 = \frac{Wa^2}{2\ (l + 2a)}$<br>At $x$: when $x < a$ $M = \frac{W}{2\ (l + 2a)}\left(a - x\right)^2$<br>At $x_1$: when $x_1 < l$<br>$M = \frac{W}{2\ (l + 2a)}\left(a + x_1\right)^2 - Rx_1$ | |

# GENERAL FORMULAE FOR BEAMS UNDER VARIOUS LOADING CONDITIONS

| LOADING DIAGRAM | REACTIONS AND SHEAR V | BENDING MOMENT M | DEFLECTION D |
|---|---|---|---|
|  | **BEAM OVERHANGING BOTH SUPPORTS, SYMMETRICALLY PLACED. TWO EQUAL CONCENTRATED LOADS AT ENDS** | | |
| | $R = R_1 = V\,(max) = \frac{W}{2}$<br>At $x$: when $x < a$<br>$V = \frac{W}{2}$ | At $x_1$: when $x_1 < l$<br>$M\,(max) = \frac{Wa}{2}$<br>At $x$: when $x < a$<br>$M = \frac{W}{2}(a - x)$ | At *free ends*<br>$D = \frac{Wa^2\,(3\,l + 2\,a)}{12\,EI}$<br>At *center*<br>$D = \frac{Wal^2}{16\,EI}$ |
|  | **BEAM OVERHANGING ONE SUPPORT. CONTINUOUS LOAD, UNIFORMLY DISTRIBUTED** | | |
| | $R = \frac{Wl}{2\,(l+a)} - \frac{Wa^2}{2\,l\,(l+a)}$<br>$R_1 = \frac{Wl}{2\,(l+a)} + \frac{Wa}{l+a} + \frac{Wa^2}{2\,l\,(l+a)}$<br>At $x$: when $x < l$<br>$V = R - \frac{Wx}{l+a}$<br>At $x_1$: when $x_1 < a$<br>$V = \frac{W}{l+a}(a - x_1)$ | At $x$: when $x = \frac{1}{2}\left(l - \frac{a^2}{l}\right)$<br>$M\,(max) = \frac{R^2\,(l+a)}{2\,W}$<br>At $x$: when $x = l$<br>$M^1\,(max) = \frac{Wa^2}{2\,(l+a)}$<br>At $x$<br>$M = Rx - \frac{Wx^2}{2\,(l+a)}$<br>At $x_1$<br>$M = \frac{W\,(a - x_1)^2}{2\,(l+a)}$ | At $x$<br>$D = \frac{1}{24\,EI}\left[4\,R\,(x^3 - l^2x) - \frac{W}{l+a}(x^4 - l^3x)\right]$<br>At $x_1$<br>$D = \frac{1}{24\,EI}\left[\frac{W}{l+a}\left(6a^2x_1^2 - 4ax_1^3 + 3\,l^3x_1 + x_1^4\right) - 8Rl^2x_1\right]$ |
|  | **BEAM OVERHANGING ONE SUPPORT. CONCENTRATED LOADS AT FREE END AND BETWEEN SUPPORTS** | | |
| | $R = \frac{Wb - W_1a}{l}$<br>$R_1 = \frac{W\,(l-b) + W_1\,(a+l)}{l}$<br>At $x$: when $x < (l - b)$<br>$V = R$<br>At $x_1$: when $x_1 > (l - b)$ and $< l$<br>$V = R - W$<br>At $x_2$: when $x_2 < a$<br>$V = W_1$ | At $x$: when $x < (l - b)$<br>$M = Rx$<br>At $x_1$: when $x_1 > (l - b)$ and $< l$<br>$M = Rx_1 - W\,(b + x_1 - l)$<br>At $x_2$<br>$M = W_1\,(a - x_2)$ | |

# MOMENTS IN FOOT-KIPS FOR CLASS E-10 ENGINE LOADING ONE TRACK OF TWO RAILS




| Trains from end of train | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kips | 142.0 | 137.0 | 127.0 | 117.0 | 107.0 | 97.0 | 90.5 | 84.0 | 77.5 | 71.0 | 66.0 | 56.0 | 46.0 | 36.0 | 26.0 | 19.5 | 13.0 | 6.5 | 0 |
| | Feet | 109 | 101 | 96 | 91 | 86 | 77 | 72 | 66 | 61 | 53 | 45 | 40 | 35 | 30 | 21 | 16 | 10 | 5 | 0 |

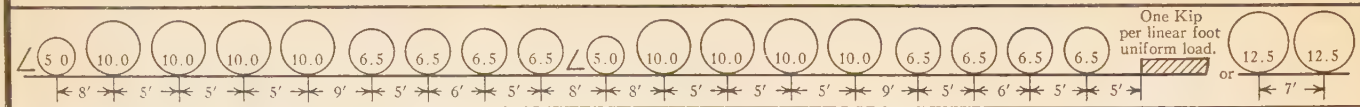
Moments of wheel loads about

| Wheel Number | End of Train | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 7872.0 | 6972.0 | 5992.0 | 5082.1 | 4222.0 | 3412.0 | 2944.0 | 2502.5 | 2112.0 | 1748.0 | 1508.0 | 1108.0 | 758.0 | 458.0 | 208.0 | 104.2 | 32.5 | | | |
| 17 | 6794.5 | 6299.5 | 5489.2 | 4729.5 | 3719.5 | 2959.5 | 2524.0 | 2121.0 | 1757.0 | 1425.5 | 1210.5 | 869.5 | 569.5 | 319.5 | 110.5 | 39.0 | 32.5 | | | |
| 16 | 6020.5 | 5395.6 | 4795.5 | 3965.5 | 3155.6 | 2455.5 | 2059.0 | 1695.0 | 1376.0 | 1077.5 | 892.5 | 602.5 | 362.5 | 172.5 | 32.5 | 39.0 | 110.5 | | | |
| 15 | 5302.9 | 4702.0 | 4162.0 | 3442.0 | 2712.0 | 2068.0 | 1764.0 | 1372.5 | 1080.0 | 820.0 | 660.0 | 420.0 | 230.0 | 90.0 | 32.5 | 104.0 | 208.0 | | | |
| 14 | 4764.6 | 4269.0 | 3829.0 | 3399.0 | 2969.0 | 1929.0 | 1429.0 | 1123.5 | 850.5 | 636.5 | 415.0 | 300.0 | 150.0 | 50.0 | 58.5 | 149.5 | 279.5 | 442.0 | | |
| 13 | 4284.0 | 3864.0 | 3464.0 | 2894.9 | 2194.0 | 1634.0 | 1124.0 | 851.0 | 610.5 | 409.0 | 240.0 | 150.0 | 50.0 | 50.0 | 141.0 | 264.5 | 427.0 | 622.0 | | |
| 12 | 3854.0 | 3469.0 | 2799.0 | 1839.0 | 1329.0 | 869.0 | 628.5 | 420.5 | 251.5 | 115.0 | 50.0 | 50.0 | 150.0 | 273.5 | 429.5 | 624.5 | 852.0 | | | |
| 11 | 3994.0 | 2694.0 | 2044.0 | 1334.0 | 1074.0 | 664.0 | 456.0 | 289.5 | 144.0 | 40.0 | 50.0 | 150.0 | 300.0 | 456.0 | 644.5 | 872.0 | 1132.0 | | | |
| 10 | 2816.0 | 2036.0 | 1556.0 | 1126.0 | 746.0 | 416.0 | 260.0 | 136.5 | 52.0 | 80.0 | 210.0 | 390.0 | 620.0 | 828.0 | 1068.5 | 1348.0 | 1660.0 | | | |
| 9 | 1748.0 | 1302.0 | 1102.0 | 772.0 | 452.6 | 208.0 | 104.0 | 32.5 | 40.0 | 200.0 | 410.0 | 670.0 | 980.0 | 1240.0 | 1532.5 | 1864.0 | 2228.0 | | | |
| 8 | 1125.5 | 1210.5 | 860.5 | 560.5 | 310.5 | 110.5 | 39.0 | 32.5 | 97.5 | 307.5 | 567.5 | 877.5 | 1237.5 | 1530.0 | 1855.0 | 2219.0 | 2615.5 | | | |
| 7 | 1077.2 | 892.5 | 602.5 | 362.5 | 172.5 | 32.5 | 39.0 | 110.5 | 265.5 | 475.5 | 795.5 | 1165.5 | 1585.5 | 1917.0 | 2281.0 | 2684.0 | 3119.5 | | | |
| 6 | 820.0 | 660.0 | 420.0 | 230.0 | 90.0 | 32.5 | 104.0 | 208.0 | 328.0 | 648.0 | 1018.0 | 1438.0 | 1908.0 | 2272.0 | 2668.5 | 3104.0 | 3572.0 | | | |
| 5 | 415.6 | 300.0 | 150.0 | 50.0 | 58.5 | 149.5 | 279.5 | 442.0 | 667.0 | 1017.0 | 1477.0 | 1987.0 | 2547.0 | 2969.5 | 3424.5 | 3918.5 | 4445.0 | | | |
| 4 | 240.0 | 150.0 | 50.0 | 50.0 | 141.0 | 264.5 | 427.0 | 622.0 | 812.0 | 1272.0 | 1782.0 | 2342.0 | 2952.0 | 3407.0 | 3394.5 | 4421.0 | 4980.0 | | | |
| 3 | 115.0 | 50.0 | 50.0 | 150.0 | 273.5 | 429.5 | 624.5 | 852.0 | 1067.0 | 1577.0 | 2137.0 | 2747.0 | 3407.0 | 3894.5 | 4414.4 | 4973.5 | 5565.0 | | | |
| 2 | 40.0 | 50.0 | 150.0 | 300.0 | 456.0 | 644.5 | 872.0 | 1132.0 | 1372.0 | 1932.0 | 2542.0 | 3202.0 | 3912.0 | 4432.0 | 4984.5 | 5576.0 | 6200.0 | | | |
| 1 | 80.0 | 210.0 | 390.0 | 620.0 | 828.0 | 1068.5 | 1348.0 | 1660.0 | 1940.0 | 2580.0 | 3270.0 | 4010.0 | 4800.0 | 5372.0 | 5976.5 | 6620.0 | 7296.0 | | | |

| Totals from wheel No. 1 | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kips | 5.0 | 15.0 | 25.0 | 35.0 | 45.0 | 51.5 | 58.0 | 64.5 | 71.0 | 76.0 | 86.0 | 96.0 | 106.0 | 116.0 | 122.5 | 129.0 | 135.5 | 142.0 | 142.0 |
| | Feet | 0 | 8 | 13 | 18 | 23 | 32 | 37 | 43 | 48 | 56 | 64 | 69 | 74 | 79 | 88 | 93 | 99 | 104 | 109 |

For E 40 loading multiply Moments tabulated above by 4; for E 50 loading multiply by 5; for E 60 loading multiply by 6.

# MAXIMUM MOMENTS, SHEARS, AND REACTIONS FOR CLASS E-10 ENGINE LOADING ONE TRACK OF TWO RAILS




| Span in Feet | Maximum Moment in Foot-Kips | Maximum Shear in Kips | Maximum Floor-beam Reaction Kips | Equivalent Uniform Load | | | Span in Feet | Maximum Moment in Foot-Kips | Maximum Shear in Kips | Maximum Floor-beam Reaction Kips | Equivalent Uniform Load | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Moment | Shear | Reaction | | | | | Moment | Shear | Reaction |
| 7 | 21.9 | 12.5 | 15.1 | 3.57 | 3.57 | 2.15 | 42 | 356.7 | 39.2 | 56.0 | 1.62 | 1.87 | 1.34 |
| 7½ | 23.5 | 13.4 | 16.0 | 3.33 | 3.56 | 2.12 | 44 | 385.8 | 40.3 | 58.2 | 1.60 | 1.83 | 1.32 |
| 8 | 25.0 | 14.0 | 16.8 | 3.12 | 3.51 | 2.11 | 46 | 414.9 | 41.4 | 60.3 | 1.57 | 1.80 | 1.31 |
| 9 | 28.1 | 15.3 | 18.2 | 2.78 | 3.39 | 2.02 | 48 | 443.8 | 42.4 | 62.4 | 1.54 | 1.77 | 1.30 |
| 10 | 31.2 | 16.2 | 19.2 | 2.50 | 3.25 | 1.92 | 50 | 475.5 | 43.5 | 64.3 | 1.52 | 1.74 | 1.29 |
| 11 | 34 4 | 17.0 | 21.0 | 2.28 | 3.09 | 1.90 | 52 | 507.6 | 44.6 | 66.7 | 1.50 | 1.72 | 1.28 |
| 12 | 40.0 | 17.7 | 23.3 | 2.22 | 2.95 | 1.94 | 54 | 540.5 | 45.6 | 69.0 | 1.48 | 1.69 | 1.28 |
| 13 | 47.5 | 18.3 | 24.6 | 2.25 | 2.81 | 1.90 | 56 | 576.1 | 46.5 | 71.4 | 1.47 | 1.66 | 1.27 |
| 14 | 55.0 | 18.8 | 26.1 | 2.25 | 2.68 | 1.86 | 58 | 611.6 | 47.7 | 74.0 | 1.46 | 1.65 | 1.28 |
| 15 | 62 5 | 20.0 | 27.3 | 2.22 | 2.67 | 1.82 | 60 | 649.5 | 48.8 | 76.6 | 1.44 | 1.63 | 1.28 |
| 16 | 70.0 | 21 3 | 28.5 | 2.19 | 2.66 | 1.78 | 62 | 688.2 | 50.0 | 79.1 | 1.43 | 1.61 | 1.27 |
| 17 | 77.5 | 22.4 | 29.4 | 2.15 | 2.63 | 1.73 | 64 | 727.7 | 51.3 | 81.5 | 1.42 | 1.60 | 1.27 |
| 18 | 85.0 | 23.3 | 30 3 | 2.10 | 2.59 | 1.69 | 66 | 769.7 | 52.5 | 83.9 | 1.41 | 1.59 | 1.27 |
| 19 | 93 3 | 24.2 | 31.5 | 2.07 | 2.55 | 1.66 | 68 | 811.7 | 53.9 | 86.2 | 1.40 | 1.59 | 1.27 |
| 20 | 103.1 | 25.0 | 32.8 | 2.06 | 2.50 | 1.64 | 70 | 853.7 | 55.3 | 88.5 | 1.39 | 1.58 | 1.26 |
| 21 | 112.9 | 25.7 | 34.0 | 2.05 | 2.45 | 1.62 | 72 | 896.7 | 56.7 | 90.7 | 1.38 | 1.58 | 1.26 |
| 22 | 122.8 | 26.3 | 35 1 | 2.03 | 2.40 | 1 60 | 74 | 939.0 | 58 1 | 93.0 | 1.37 | 1.57 | 1.26 |
| 23 | 132.7 | 27.0 | 36.1 | 2.01 | 2.34 | 1 57 | 76 | 986.0 | 59.5 | 95.2 | 1.36 | 1.57 | 1.25 |
| 24 | 142.6 | 27.7 | 37.0 | 1.98 | 2.31 | 1.54 | 78 | 1032.7 | 60.9 | 97.3 | 1.36 | 1.56 | 1.25 |
| 25 | 152.5 | 28.4 | 37.8 | 1.95 | 2.27 | 1.51 | 80 | 1080.0 | 62.1 | 99.4 | 1.35 | 1.55 | 1.24 |
| 26 | 162.4 | 29 1 | 38.8 | 1.92 | 2.24 | 1.49 | 82 | 1128.3 | 63.5 | 101.5 | 1.34 | 1.55 | 1.24 |
| 27 | 172.3 | 29.6 | 40 0 | 1.89 | 2.20 | 1.48 | 84 | 1177.7 | 64.8 | 103.5 | 1.34 | 1.54 | 1.23 |
| 28 | 182.7 | 30 2 | 41.2 | 1.86 | 2.16 | 1.47 | 86 | 1229.7 | 66.1 | 105.4 | 1.33 | 1.54 | 1.23 |
| 29 | 194 0 | 30.8 | 42.2 | 1.84 | 2.12 | 1.46 | 88 | 1282.0 | 67.4 | 107.3 | 1.32 | 1.53 | 1.22 |
| 30 | 205.2 | 31.5 | 43.1 | 1 82 | 2.10 | 1.44 | 90 | 1334.7 | 68.6 | 109.3 | 1.32 | 1.53 | 1.22 |
| 31 | 216.5 | 32.2 | 44.3 | 1.80 | 2.08 | 1 43 | 92 | 1388.3 | 69.9 | 111.2 | 1.31 | 1.52 | 1.21 |
| 32 | 227.7 | 32 9 | 45.5 | 1.78 | 2.05 | 1.42 | 94 | 1442.7 | 71.2 | 113.1 | 1.31 | 1.52 | 1.20 |
| 33 | 239.0 | 33.5 | 46.7 | 1.75 | 2.03 | 1.41 | 96 | 1497.3 | 72.4 | 115.0 | 1.30 | 1.51 | 1.20 |
| 34 | 250.3 | 34.1 | 47.8 | 1.73 | 2.00 | 1.40 | 98 | 1552.7 | 73.7 | 116.8 | 1.29 | 1.51 | 1.19 |
| 35 | 261.5 | 34.6 | 48.8 | 1.71 | 1.98 | 1.39 | 100 | 1609.7 | 75.0 | 118.6 | 1.29 | 1.50 | 1.19 |
| 36 | 274.3 | 35.3 | 49.8 | 1.69 | 1.96 | 1.38 | 125 | 2497.7 | 89.7 | 140.5 | 1.28 | 1.44 | 1.12 |
| 37 | 287.2 | 35.9 | 50.7 | 1.68 | 1.94 | 1.37 | 150 | 3531.0 | 103.7 | 162.7 | 1.25 | 1.38 | 1.08 |
| 38 | 300 0 | 36.5 | 51.8 | 1.66 | 1.92 | 1.36 | 175 | 4676.3 | 117.3 | 185.8 | 1.22 | 1.34 | 1.06 |
| 39 | 313.3 | 37.2 | 52.9 | 1.65 | 1.90 | 1.36 | 200 | 5939.0 | 130.5 | 209.5 | 1.19 | 1.31 | 1.05 |
| 40 | 327.8 | 37 7 | 54.0 | 1.64 | 1.88 | 1.35 | 250 | 8796.3 | 156.6 | 257.6 | 1.13 | 1.25 | 1.03 |

# DEFLECTION

Based on Modulus of Elasticity of 29 000 000.

$D = \frac{0.01862\ L^2}{d}$

Def. Coef. = $0.01862\ L^2$

D = Deflection in inches for Symmetrical Beams and Girders, simple span, uniformly loaded to cause an 18000 # per sq. in. stress in the extreme fibre of the flange. (See notes below).

L = Span in feet  d = depth in inches

For deflection of beams of depths not listed below divide the Deflection Coefficient by the depth in inches.

| Span in Feet | Deflection Coefficient | d = depth in inches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 15 |
| 3 | .1676 | .056 | .042 | .033 | .028 | .024 | .021 | .019 | .017 | .014 | .012 | .011 |
| 4 | .2979 | .099 | .074 | .059 | .050 | .043 | .037 | .033 | .030 | .025 | .021 | .020 |
| 5 | .4655 | .155 | .116 | .093 | .078 | .067 | .058 | .052 | .047 | .039 | .033 | .031 |
| 6 | .6703 | .223 | .168 | .134 | .112 | .096 | .084 | .074 | .067 | .056 | .048 | .045 |
| 7 | .9123 | .304 | .228 | .182 | .152 | .130 | .114 | .101 | .091 | .076 | .065 | .061 |
| 8 | 1.192 | .396 | .298 | .238 | .198 | .170 | .149 | .132 | .119 | .099 | .085 | .079 |
| 9 | 1.508 | .503 | .378 | .302 | .252 | .216 | .189 | .168 | .151 | .126 | .108 | .101 |
| 10 | 1.862 | .620 | .465 | .372 | .310 | .266 | .233 | .207 | .186 | .155 | .133 | .124 |
| 11 | 2.253 | .750 | .562 | .450 | .375 | .321 | .281 | .250 | .225 | .188 | .161 | .150 |
| 12 | 2.681 | .896 | .670 | 537 | .447 | .383 | .335 | .298 | .268 | .223 | .192 | .179 |
| 13 | 3.147 | 1.05 | .787 | .630 | .525 | .450 | .394 | .350 | .315 | .263 | .225 | .210 |
| 14 | 3.650 | 1.22 | .912 | .730 | 608 | 521 | .456 | .406 | 365 | .304 | .261 | .243 |
| 15 | 4.190 | 1.39 | 1.05 | .838 | .698 | .599 | 524 | .466 | .419 | .349 | .299 | .279 |
| 16 | 4.767 | .... | 1.19 | .955 | .795 | .681 | .596 | .530 | .477 | .398 | .341 | .318 |
| 17 | 5.381 | .... | 1.35 | 1.08 | .897 | 769 | 673 | .598 | .538 | .448 | .384 | .359 |
| 18 | 6.033 | .... | 1.51 | 1 20 | 1.01 | 861 | .754 | 670 | .603 | .503 | .431 | .402 |
| 19 | 6.722 | .... | 1.68 | 1.34 | 1.12 | 960 | .840 | 747 | .672 | .560 | .480 | .448 |
| 20 | 7.448 | .... | 1.86 | 1.49 | 1.24 | 1.06 | .931 | .828 | .745 | .621 | .530 | .497 |
| 21 | 8.211 | .... | .... | 1.64 | 1.37 | 1.17 | 1.03 | .912 | 821 | .684 | .587 | .547 |
| 22 | 9.012 | .... | . . | 1.80 | 1.51 | 1 29 | 1.13 | 1.00 | .901 | 751 | .644 | .601 |
| 23 | 9.850 | .... | . . | 1.97 | 1.64 | 1.41 | 1.23 | 1 10 | 985 | .820 | .704 | .657 |
| 24 | 10.725 | . . | .... | 2.14 | 1 79 | 1.53 | 1 34 | 1 19 | 1 07 | .894 | .766 | .715 |
| 25 | 11.638 | .. | .... | 2.33 | 1.94 | 1 66 | 1 46 | 1.29 | 1.16 | .970 | .831 | .776 |
| 26 | 12.587 | .... | .... | ... | 2.10 | 1.80 | 1.57 | 1 40 | 1.26 | 1.05 | .899 | .839 |
| 27 | 13.574 | .... | .... | .... | 2.26 | 1.94 | 1 70 | 1 51 | 1 36 | 1.13 | .970 | 905 |
| 28 | 14.598 | .... | .... | .. | 2.43 | 2 09 | 1 83 | 1 62 | 1 46 | 1.22 | 1.04 | .973 |
| 29 | 15.659 | .... | . .. | .... | 2.61 | 2.24 | 1 96 | 1 74 | 1 57 | 1 31 | 1.12 | 1.04 |
| 30 | 16.758 | .... | .... | .... | 2.79 | 2.39 | 2 10 | 1 86 | 1 68 | 1.40 | 1.20 | 1.12 |
| 31 | 17.894 | .... | .... | .. | .. | 2.56 | 2 24 | 1.99 | 1 79 | 1 49 | 1 28 | 1 19 |
| 32 | 19.067 | .... | .... | .... | .. | 2.72 | 2 38 | 2.12 | 1 91 | 1.59 | 1 36 | 1.27 |
| 33 | 20.277 | .... | .... | .... | .... | 2.90 | 2.54 | 2.25 | 2 03 | 1.69 | 1 45 | 1.35 |
| 34 | 21.525 | .... | .... | .... | . | 3.08 | 2 69 | 2.39 | 2 15 | 1 79 | 1.54 | 1.44 |
| 35 | 22.810 | .. | .. | .... | . | 3.26 | 2 85 | 2.53 | 2 28 | 1 90 | 1 63 | 1.52 |
| 36 | 24.132 | . . | . .. | . . | . | . | 3 02 | 2 68 | 2.41 | 2.01 | 1 72 | 1.61 |
| 37 | 25 491 | . | .. | . . | . | . | 3 19 | 2 83 | 2.55 | 2.13 | 1 82 | 1.70 |
| 38 | 26.887 | . . | . | .... | . | . | 3 36 | 2 99 | 2.69 | 2.24 | 1 92 | 1.79 |
| 39 | 28 321 | . | . .. | .... | . | . | 3 54 | 3 15 | 2.83 | 2.36 | 2.02 | 1.89 |
| 40 | 29 792 | . | .... | .... | . | . | 3 72 | 3 31 | 2.98 | 2.48 | 2.13 | 1.99 |
| 42 | 32.846 | . | . .. | . . | . | . | . | 3 65 | 3 29 | 2 74 | 2.35 | 2.19 |
| 44 | 36 048 | . | . .. | . . | . | . | . | 4 01 | 3 61 | 3 00 | 2.57 | 2.40 |
| 46 | 39.400 | .. | . . | . . | . . | . | . | . | 3.94 | 3 28 | 2.81 | 2 63 |
| 48 | 42 901 | . | . .. | . . | . | . | . | . | 4 29 | 3 58 | 3 06 | 2.86 |
| 50 | 46 550 | . | . .. | . . | . . | . . | . . | . | 4 66 | 3.88 | 3.33 | 3.10 |
| 52 | 50 348 | .... | . .. | . . | . . | . | . | . | . | 4.20 | 3 60 | 3.36 |
| 54 | 54 296 | .... | .... | . | . | . . | . . | . | . | 4.53 | 3 88 | 3.62 |
| 56 | 58 392 | . . | .... | . | . | .. | . | . | . | 4 87 | 4 17 | 3.89 |
| 58 | 62 638 | . . | .... | .... | . . | . | . | . | . | 5 22 | 4 47 | 4.18 |
| 60 | 67 032 | . . | .... | .... | .... | . . | .. | . . | . . | 5 59 | 4 79 | 4.47 |
| 65 | 78 670 | .... | .... | . . | .. | . | .. | .... | . . | | 5.62 | 5.24 |
| 70 | 91 238 | .... | .. | .... | .... | .... | .... | .... | .... | .. | 6.52 | 6.08 |
| 75 | 104 738 | . . | .... | .... | .... | .... | .... | .... | .... | .. | . . | 6.98 |
| 80 | 119 168 | . . | . . | . . | .... | .... | .... | .... | .... | .. | . . | 7.94 |
| 85 | 134 530 | .... | . . | . . | .... | .... | .... | .... | .... | .... | .... | 8.97 |

For Simple Spans a Concentrated Center Load causing an 18000 # per sq. inch fibre stress is 50% of the Uniformly Distributed Load. Deflection caused by a Concentrated Center Load is $0.01490\ L^2$ or 80% of that of a Uniformly Distributed Load shown in the above tables.

For fibre stresses other than 18000 # per sq. inch on which the above table is based, the deflection is directly proportional to the flange stress developed. Thus a fibre stress of 12000 # per sq. inch gives a deflection equal to ⅔ of that shown in the above tables.

# DEFLECTION

Based on Modulus of Elasticity of 29 000 000.

$D = \frac{0.01862\ L^2}{d}$

Def. Coef. $= 0.01862\ L^2$

D = Deflection in inches for Symmetrical Beams and Girders, simple span, uniformly loaded to cause an 18000 # per sq. in. stress in the extreme fibre of the flange. (See notes below).

L = Span in feet  d = depth in inches

For deflection of beams of depths not listed below divide the Deflection Coefficient by the depth in inches.

| Span in Feet | Deflection Coefficient | d = depth in inches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 16 | 18 | 20 | 21 | 22 | 24 | 26 | 27 | 28 | 30 | 33 |
| 6 | .6703 | .042 | .037 | .034 | .032 | .030 | .028 | .026 | .025 | .024 | .022 | .020 |
| 7 | .9123 | .057 | .051 | .046 | .043 | .041 | .038 | .035 | .034 | .033 | .030 | .028 |
| 8 | 1.192 | .075 | .066 | .060 | .057 | .054 | .050 | .046 | .044 | .043 | .040 | .036 |
| 9 | 1.508 | .094 | .084 | .076 | .072 | .069 | .063 | .058 | .056 | .054 | .050 | .046 |
| 10 | 1.862 | .116 | .103 | .093 | .089 | .085 | .078 | .072 | .069 | .066 | .062 | .056 |
| 11 | 2.253 | .141 | .125 | .113 | .107 | .102 | .094 | .087 | .083 | .080 | .075 | .068 |
| 12 | 2.681 | .168 | .149 | .134 | .123 | .122 | .112 | .103 | .099 | .096 | .089 | .081 |
| 13 | 3.147 | .197 | .175 | .158 | .150 | .143 | .131 | .121 | .117 | .113 | .105 | .095 |
| 14 | 3.650 | .228 | .203 | .183 | .174 | .166 | .152 | .140 | .135 | .123 | .122 | .111 |
| 15 | 4.190 | .262 | .233 | .210 | .200 | .191 | .175 | .161 | .155 | .150 | .140 | .127 |
| 16 | 4.767 | .298 | .265 | .239 | .227 | .217 | .199 | .183 | .177 | .170 | .159 | .144 |
| 17 | 5.381 | .336 | .299 | .269 | .256 | .245 | .224 | .207 | .199 | .192 | .179 | .163 |
| 18 | 6.033 | .377 | .335 | .302 | .287 | .274 | .251 | .232 | .223 | .215 | .201 | .183 |
| 19 | 6.722 | .420 | .373 | .336 | .320 | .305 | .280 | .258 | .249 | .240 | .224 | .204 |
| 20 | 7.448 | .466 | .414 | .373 | .355 | .339 | .310 | .287 | .276 | .266 | .248 | .226 |
| 21 | 8.211 | .513 | .456 | .411 | .391 | .373 | .342 | .316 | .304 | .293 | .274 | .249 |
| 22 | 9.012 | .563 | .501 | .451 | .429 | .410 | .375 | .347 | .334 | .322 | .300 | .273 |
| 23 | 9.850 | .616 | .547 | .493 | .469 | .448 | .410 | .379 | .365 | .352 | .328 | .298 |
| 24 | 10.725 | .670 | .596 | .537 | .511 | .488 | .447 | .413 | .397 | .383 | .358 | .325 |
| 25 | 11.638 | .727 | .647 | .582 | .554 | .529 | .485 | .448 | .431 | .416 | .388 | .353 |
| 26 | 12.587 | .787 | .699 | .630 | .600 | .572 | .525 | .484 | .466 | .450 | .420 | .381 |
| 27 | 13.574 | .848 | .754 | .679 | .646 | .617 | .566 | .522 | .503 | .485 | .452 | .411 |
| 28 | 14.598 | .912 | .811 | .736 | .695 | .664 | .608 | .562 | .540 | .521 | .487 | .442 |
| 29 | 15.659 | .979 | .870 | .783 | .746 | .712 | .653 | .602 | .580 | .559 | .522 | .475 |
| 30 | 16.758 | 1.05 | .931 | .838 | .798 | .762 | .698 | .645 | .621 | .599 | .559 | .508 |
| 31 | 17.894 | 1.12 | .994 | .895 | .852 | .813 | .746 | .688 | .662 | .639 | .596 | .542 |
| 32 | 19.067 | 1.19 | 1.06 | .954 | .908 | .867 | .795 | .733 | .706 | .681 | .636 | .578 |
| 33 | 20.277 | 1.27 | 1.13 | 1.01 | .966 | .927 | .845 | .780 | .751 | .724 | .676 | .614 |
| 34 | 21.525 | 1.35 | 1.20 | 1.08 | 1.03 | .979 | .897 | .832 | .797 | .769 | .718 | .652 |
| 35 | 22.810 | 1.43 | 1.27 | 1.14 | 1.09 | 1.04 | .950 | .877 | .844 | .815 | .760 | .691 |
| 36 | 24.132 | 1.51 | 1.34 | 1.21 | 1.15 | 1.10 | 1.01 | .928 | .894 | .862 | .804 | .731 |
| 37 | 25.491 | 1.59 | 1.42 | 1.28 | 1.21 | 1.16 | 1.06 | .981 | .944 | .911 | .850 | .772 |
| 38 | 26.887 | 1.68 | 1.49 | 1.34 | 1.28 | 1.22 | 1.12 | 1.03 | .996 | .960 | .896 | .815 |
| 39 | 28.321 | 1.77 | 1.57 | 1.42 | 1.35 | 1.29 | 1.18 | 1.09 | 1.05 | 1.01 | .944 | .858 |
| 40 | 29.792 | 1.86 | 1.66 | 1.49 | 1.42 | 1.35 | 1.24 | 1.15 | 1.10 | 1.06 | .993 | .903 |
| 42 | 32.846 | 2.05 | 1.83 | 1.64 | 1.56 | 1.49 | 1.37 | 1.26 | 1.22 | 1.17 | 1.10 | .995 |
| 44 | 36.048 | 2.25 | 2.00 | 1.80 | 1.72 | 1.64 | 1.50 | 1.39 | 1.34 | 1.29 | 1.20 | 1.09 |
| 46 | 39.400 | 2.46 | 2.19 | 1.97 | 1.88 | 1.79 | 1.64 | 1.52 | 1.46 | 1.40 | 1.31 | 1.19 |
| 48 | 42.901 | 2.68 | 2.38 | 2.15 | 2.04 | 1.95 | 1.79 | 1.65 | 1.59 | 1.53 | 1.43 | 1.30 |
| 50 | 46.550 | 2.91 | 2.59 | 2.33 | 2.21 | 2.12 | 1.94 | 1.79 | 1.72 | 1.66 | 1.55 | 1.41 |
| 52 | 50.348 | 3.15 | 2.80 | 2.52 | 2.40 | 2.29 | 2.10 | 1.94 | 1.86 | 1.80 | 1.68 | 1.53 |
| 54 | 54.296 | 3.39 | 3.02 | 2.72 | 2.59 | 2.47 | 2.26 | 2.09 | 2.01 | 1.94 | 1.81 | 1.65 |
| 56 | 58.392 | 3.65 | 3.24 | 2.92 | 2.78 | 2.65 | 2.43 | 2.25 | 2.16 | 2.09 | 1.95 | 1.77 |
| 58 | 62.638 | 3.91 | 3.48 | 3.13 | 2.98 | 2.85 | 2.61 | 2.41 | 2.32 | 2.24 | 2.09 | 1.90 |
| 60 | 67.032 | 4.19 | 3.72 | 3.35 | 3.19 | 3.05 | 2.79 | 2.58 | 2.48 | 2.39 | 2.23 | 2.03 |
| 65 | 78.670 | 4.92 | 4.37 | 3.93 | 3.75 | 3.58 | 3.28 | 3.03 | 2.91 | 2.81 | 2.62 | 2.38 |
| 70 | 91.238 | 5.70 | 5.07 | 4.56 | 4.34 | 4.15 | 3.80 | 3.51 | 3.38 | 3.26 | 3.04 | 2.76 |
| 75 | 104.738 | 6.55 | 5.82 | 5.24 | 4.99 | 4.76 | 4.36 | 4.03 | 3.88 | 3.74 | 3.49 | 3.17 |
| 80 | 119.168 | 7.45 | 6.62 | 5.96 | 5.68 | 5.42 | 4.97 | 4.58 | 4.41 | 4.26 | 3.97 | 3.61 |
| 85 | 134.530 | .... | 7.47 | 6.73 | 6.41 | 6.12 | 5.61 | 5.17 | 4.98 | 4.80 | 4.48 | 4.08 |
| 90 | 150.822 | .... | 8.38 | 7.54 | 7.18 | 6.89 | 6.28 | 5.81 | 5.59 | 5.39 | 5.03 | 4.57 |
| 95 | 168.046 | .... | .... | 8.40 | 8.00 | 7.64 | 7.00 | 6.46 | 6.22 | 6.00 | 5.60 | 5.09 |
| 100 | 186.200 | .... | .... | .... | 8.87 | 8.46 | 7.76 | 7.16 | 6.90 | 6.65 | 6.21 | 5.64 |

For Simple Spans a Concentrated Center Load causing an 18000 # per sq. inch fibre stress is 50% of the Uniformly Distributed Load. Deflection caused by a Concentrated Center Load is $0.01490\ L^2$ or 80% of that of a Uniformly Distributed Load shown in the above tables.

For fibre stresses other than 18000 # per sq. inch on which the above table is based, the deflection is directly proportional to the flange stress developed. Thus a fibre stress of 12000 # per sq. inch gives a deflection equal to ⅔ of that shown in the above tables.

# DEFLECTION

Based on Modulus of Elasticity of 29 000 000.

$D = \frac{0.01862\ L^2}{d}$

Def. Coef. = $0.01862\ L^2$

D = Deflection in inches for Symmetrical Beams and Girders, simple span, uniformly loaded to cause an 18000 # per sq. in. stress in the extreme fibre of the flange. (See notes below).

L = Span in feet  d = depth in inches

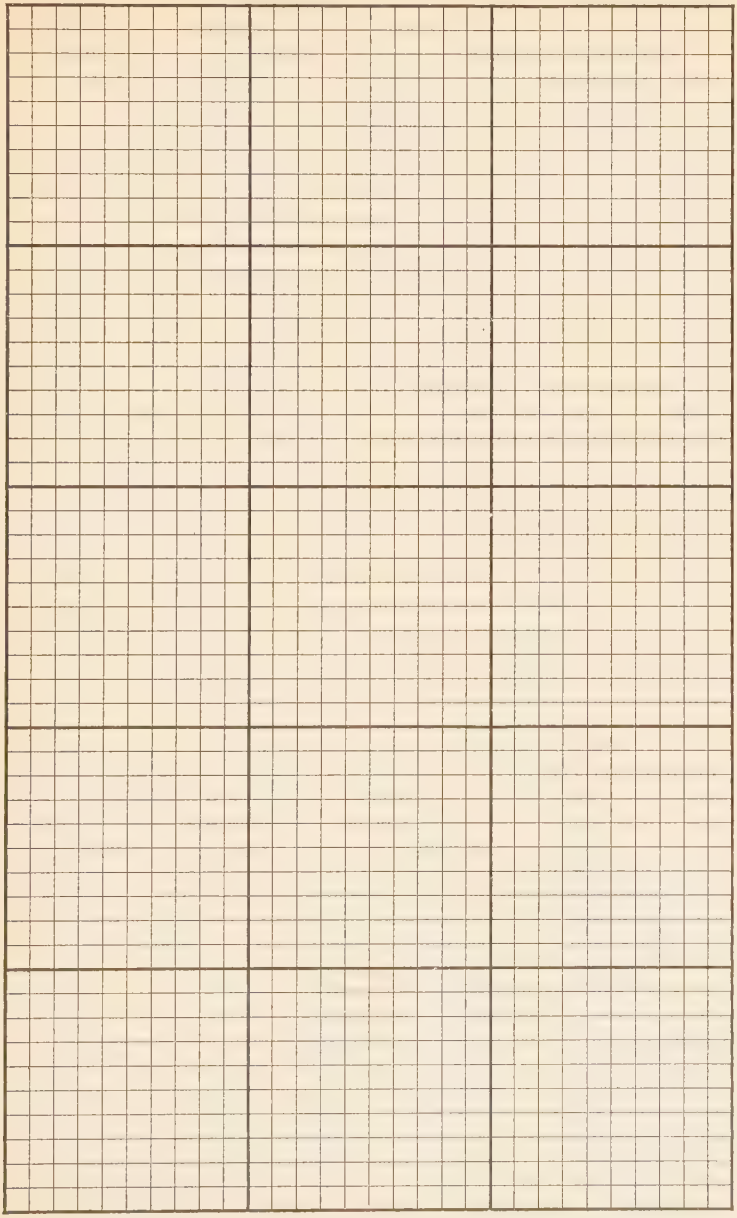
For deflection of beams of depths not listed below divide the Deflection Coefficient by the depth in inches.

| Span in Feet | Deflection Coefficient | d = depth in inches. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 36 | 39 | 42 | 48 | 54 | 60 | 66 | 72 | 84 | 96 | 108 |
| 6 | .6703 | .019 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 7 | .9123 | .025 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 8 | 1.192 | .033 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 9 | 1.508 | .042 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 10 | 1.862 | .052 | .048 | .044 | .039 | .... | .... | .... | .... | .... | .... | .... |
| 11 | 2.253 | .063 | .058 | .054 | .047 | .... | .... | .... | .... | .... | .... | .... |
| 12 | 2.681 | .074 | .069 | .064 | .056 | .... | .... | .... | .... | .... | .... | .... |
| 13 | 3.147 | .087 | .081 | .075 | .066 | .... | .... | .... | .... | .... | .... | .... |
| 14 | 3.650 | .101 | .094 | .087 | .076 | .... | .... | .... | .... | .... | .... | .... |
| 15 | 4.190 | .116 | .107 | .100 | .087 | .078 | .070 | .... | .... | .... | .... | .... |
| 16 | 4.767 | .132 | .122 | .114 | .099 | .088 | .080 | .... | .... | .... | .... | .... |
| 17 | 5.381 | .149 | .138 | .128 | .112 | .100 | .090 | .... | .... | .... | .... | .... |
| 18 | 6.033 | .168 | .155 | .144 | .126 | .112 | .101 | .... | .... | .... | .... | .... |
| 19 | 6.722 | .187 | .172 | .160 | .140 | .124 | .112 | .... | .... | .... | .... | .... |
| 20 | 7.448 | .207 | .191 | .177 | .155 | .138 | .124 | .113 | .103 | .088 | .078 | .069 |
| 21 | 8.211 | .228 | .211 | .195 | .171 | .152 | .137 | .124 | .114 | .098 | .086 | .076 |
| 22 | 9.012 | .250 | .231 | .215 | .188 | .167 | .150 | .137 | .125 | .107 | .094 | .083 |
| 23 | 9.850 | .274 | .253 | .235 | .205 | .183 | .164 | .149 | .137 | .117 | .103 | .091 |
| 24 | 10.725 | .298 | .275 | .255 | .224 | .199 | .179 | .163 | .149 | .128 | .112 | .099 |
| 25 | 11.638 | .323 | .298 | .277 | .243 | .216 | .194 | .176 | .162 | .139 | .121 | .108 |
| 26 | 12.587 | .350 | .323 | .300 | .262 | .233 | .210 | .191 | .175 | .150 | .131 | .117 |
| 27 | 13.574 | .377 | .348 | .323 | .283 | .251 | .226 | .206 | .188 | .162 | .141 | .126 |
| 28 | 14.598 | .406 | .374 | .348 | .304 | .270 | .243 | .221 | .203 | .174 | .152 | .135 |
| 29 | 15.659 | .435 | .402 | .373 | .326 | .290 | .261 | .237 | .218 | .186 | .163 | .145 |
| 30 | 16.758 | .466 | .430 | .399 | .349 | .310 | .279 | .254 | .233 | .200 | .175 | .155 |
| 31 | 17.894 | .497 | .459 | .426 | .373 | .331 | .298 | .271 | .249 | .213 | .186 | .166 |
| 32 | 19.067 | .530 | .489 | .454 | .398 | .353 | .318 | .289 | .265 | .227 | .199 | .177 |
| 33 | 20.277 | .563 | .520 | .483 | 423 | .376 | .338 | .307 | .282 | .241 | .211 | .188 |
| 34 | 21.525 | .598 | .552 | .513 | .449 | .399 | .359 | .326 | .299 | .256 | .224 | .199 |
| 35 | 22.810 | .634 | .585 | .543 | 475 | .422 | .380 | .346 | .317 | .272 | .238 | .211 |
| 36 | 24.132 | 670 | .619 | .575 | 503 | .447 | .402 | .366 | .335 | .287 | .251 | .223 |
| 37 | 25.491 | .708 | .654 | .607 | 531 | 472 | .425 | .386 | .354 | .304 | .266 | .236 |
| 38 | 26.887 | .747 | .689 | .640 | .560 | 498 | .448 | .407 | .373 | .320 | .280 | .249 |
| 39 | 28.321 | 787 | .726 | .674 | 590 | 525 | .472 | .429 | .393 | .337 | .295 | .262 |
| 40 | 29.792 | 828 | 764 | 709 | 621 | 552 | .497 | .451 | .414 | .355 | .310 | .276 |
| 42 | 32.846 | 912 | 842 | 782 | 684 | 608 | .548 | .498 | .456 | .390 | .342 | .304 |
| 44 | 36 048 | 1 00 | 924 | .858 | 751 | .668 | .601 | .546 | .501 | .429 | .376 | .334 |
| 46 | 39.400 | 1 09 | 1 01 | 938 | .821 | .730 | 657 | .597 | .547 | .469 | .410 | .365 |
| 48 | 42.901 | 1 19 | 1 10 | 1 02 | 894 | .794 | .745 | .650 | .596 | .511 | .447 | .397 |
| 50 | 46.550 | 1 29 | 1 19 | 1 11 | 970 | .862 | 776 | .705 | .647 | .554 | .485 | .431 |
| 52 | 50 348 | 1 40 | 1 29 | 1 20 | 1 05 | 932 | 839 | .763 | .699 | .599 | .524 | .466 |
| 54 | 54.296 | 1 51 | 1 39 | 1 29 | 1 11 | 1 01 | 905 | .823 | .754 | .646 | .566 | .503 |
| 56 | 58.392 | 1 62 | 1 50 | 1 39 | 1 22 | 1.08 | 973 | .885 | .811 | .695 | .608 | .541 |
| 58 | 62 638 | 1 74 | 1 61 | 1.49 | 1 31 | 1.16 | 1 04 | .949 | .870 | .746 | .653 | .580 |
| 60 | 67 032 | 1 86 | 1 72 | 1 60 | 1 40 | 1.24 | 1 12 | 1.02 | .931 | .798 | 698 | .621 |
| 65 | 78.670 | 2 19 | 2 02 | 1 87 | 1 64 | 1 46 | 1 31 | 1.19 | 1 09 | .937 | .819 | .728 |
| 70 | 91.238 | 2 53 | 2 34 | 2 17 | 1 90 | 1 69 | 1 52 | 1 38 | 1 27 | 1 09 | .950 | .845 |
| 75 | 104.738 | 2 91 | 2 69 | 2 49 | 2 18 | 1 94 | 1 75 | 1.59 | 1.45 | 1.25 | 1 09 | .970 |
| 80 | 119.168 | 3 31 | 3 06 | 2 84 | 2 48 | 2 21 | 1 99 | 1 81 | 1.66 | 1.42 | 1.24 | 1.10 |
| 85 | 134.530 | 3 74 | 3 45 | 3 20 | 2 81 | 2.49 | 2.24 | 2.04 | 1.87 | 1.60 | 1.40 | 1.25 |
| 90 | 150.822 | 4 19 | 3 87 | 3 59 | 3.14 | 2 79 | 2 51 | 2.29 | 2.10 | 1.80 | 1.57 | 1.40 |
| 95 | 168.046 | 4 67 | 4 31 | 4 00 | 3 50 | 3 11 | 2.80 | 2.55 | 2.33 | 2.00 | 1.75 | 1.56 |
| 100 | 186.200 | 5 17 | 4 77 | 4 43 | 3 88 | 3 45 | 3.10 | 2.82 | 2.59 | 2.22 | 1.94 | 1.72 |

For Simple Spans a Concentrated Center Load causing an 18000 # per sq. inch fibre stress is 50% of the Uniformly Distributed Load. Deflection caused by a Concentrated Center Load is $0.01490\ L^2$ or 80% of that of a Uniformly Distributed Load shown in the above tables.

For fibre stresses other than 18000 # per sq. inch on which the above table is based, the deflection is directly proportional to the flange stress developed. Thus a fibre stress of 12000 # per sq. inch gives a deflection equal to ⅔ of that shown in the above tables.

## NOTES and DIAGRAMS



# .01 TO .49 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| .01 | .0001 | .000001 | 0.1000 | 0.2154 | $\bar{2}$.00000 | 100000.000 | .03142 | .000079 |
| .02 | .0004 | .000008 | 0.1414 | 0.2714 | $\bar{2}$.30103 | 50000.000 | .06283 | .000314 |
| .03 | .0009 | .000027 | 0.1732 | 0.3107 | $\bar{2}$.47712 | 33333.333 | .09425 | .000707 |
| .04 | .0016 | .000064 | 0.2000 | 0.3420 | $\bar{2}$.60206 | 25000.000 | .12566 | .001257 |
| .05 | .0025 | .000125 | 0.2236 | 0.3684 | $\bar{2}$.69897 | 20000.000 | .15708 | .001964 |
| .06 | .0036 | .000216 | 0.2449 | 0.3915 | $\bar{2}$.77815 | 16666.667 | .18850 | .002827 |
| .07 | .0049 | .000343 | 0.2646 | 0.4121 | $\bar{2}$.84510 | 14285.714 | .21991 | .003849 |
| .08 | .0064 | .000512 | 0.2828 | 0.4309 | $\bar{2}$.90309 | 12500.000 | .25133 | .005027 |
| .09 | .0081 | .000729 | 0.3000 | 0.4481 | $\bar{2}$.95424 | 11111.111 | .28274 | .006362 |
| .10 | .0100 | .001000 | 0.3162 | 0.4642 | $\bar{1}$.00000 | 10000.000 | .31416 | .007854 |
| .11 | .0121 | .001331 | 0.3317 | 0.4791 | $\bar{1}$.04139 | 9090.909 | .34558 | .009503 |
| .12 | .0144 | .001728 | 0.3464 | 0.4932 | $\bar{1}$.07918 | 8333.333 | .37699 | .011310 |
| .13 | .0169 | .002197 | 0.3606 | 0.5066 | $\bar{1}$.11394 | 7692.308 | .40841 | .013273 |
| .14 | .0196 | .002744 | 0.3742 | 0.5192 | $\bar{1}$.14613 | 7142.857 | .43982 | .015394 |
| .15 | .0225 | .003375 | 0.3873 | 0.5313 | $\bar{1}$.17609 | 6666.667 | .47124 | .017672 |
| .16 | .0256 | .004096 | 0.4000 | 0.5429 | $\bar{1}$.20412 | 6250.000 | .50265 | .020106 |
| .17 | .0289 | .004913 | 0.4123 | 0.5540 | $\bar{1}$.23045 | 5882.353 | .53407 | .022698 |
| .18 | .0324 | .005832 | 0.4243 | 0.5646 | $\bar{1}$.25527 | 5555.556 | .56549 | .025447 |
| .19 | .0361 | .006859 | 0.4359 | 0.5749 | $\bar{1}$.27875 | 5263.158 | .59690 | .028353 |
| .20 | .0400 | .008000 | 0.4472 | 0.5848 | $\bar{1}$.30103 | 5000.000 | .62832 | .031416 |
| .21 | .0441 | .009261 | 0.4583 | 0.5944 | $\bar{1}$.32222 | 4761.905 | .65973 | .034636 |
| .22 | .0484 | .010648 | 0.4690 | 0.6037 | $\bar{1}$.34242 | 4545.455 | .69115 | .038013 |
| .23 | .0529 | .012167 | 0.4796 | 0.6127 | $\bar{1}$.36173 | 4347.826 | .72257 | .041548 |
| .24 | .0576 | .013824 | 0.4899 | 0.6214 | $\bar{1}$.38021 | 4166.667 | .75398 | .045239 |
| .25 | .0625 | .015625 | 0.5000 | 0.6300 | $\bar{1}$.39794 | 4000.000 | .78540 | .049087 |
| .26 | .0676 | .017576 | 0.5099 | 0.6383 | $\bar{1}$.41497 | 3846.154 | .81681 | .053093 |
| .27 | .0729 | .019683 | 0.5196 | 0.6463 | $\bar{1}$.43136 | 3703.704 | .84823 | .057256 |
| .28 | .0784 | .021952 | 0.5292 | 0.6542 | $\bar{1}$.44716 | 3571.429 | .87965 | .061575 |
| .29 | .0841 | .024389 | 0.5385 | 0.6619 | $\bar{1}$.46240 | 3448.276 | .91106 | .066052 |
| .30 | .0900 | .027000 | 0.5477 | 0.6694 | $\bar{1}$.47712 | 3333.333 | .94248 | .070686 |
| .31 | .0961 | .029791 | 0.5568 | 0.6768 | $\bar{1}$.49136 | 3225.807 | .97389 | .075477 |
| .32 | .1024 | .032768 | 0.5657 | 0.6840 | $\bar{1}$.50515 | 3125.000 | 1 00531 | .080425 |
| .33 | .1089 | .035937 | 0.5745 | 0.6910 | $\bar{1}$.51851 | 3030.303 | 1.03673 | .085530 |
| .34 | .1156 | .039304 | 0.5831 | 0.6980 | $\bar{1}$.53148 | 2941.177 | 1.06814 | .090792 |
| .35 | .1225 | .042875 | 0.5916 | 0.7047 | $\bar{1}$ 54407 | 2857.143 | 1.09956 | .096211 |
| .36 | .1296 | .046656 | 0.6000 | 0.7114 | $\bar{1}$.55630 | 2777.778 | 1.13097 | .101788 |
| .37 | .1369 | .050653 | 0.6083 | 0.7179 | $\bar{1}$ 56820 | 2702.703 | 1.16239 | .107521 |
| .38 | .1444 | .054872 | 0 6164 | 0.7243 | $\bar{1}$.57978 | 2631.579 | 1.19381 | .113411 |
| .39 | .1521 | .059319 | 0.6245 | 0 7306 | $\bar{1}$.59106 | 2564.103 | 1.22522 | .119459 |
| .40 | .1600 | .064000 | 0.6325 | 0 7368 | $\bar{1}$.60206 | 2500.000 | 1.2566 | .125664 |
| .41 | .1681 | .068921 | 0.6403 | 0.7429 | $\bar{1}$.61278 | 2439.024 | 1.2881 | .132025 |
| .42 | .1764 | .074088 | 0.6481 | 0.7489 | $\bar{1}$.62325 | 2380.952 | 1.3195 | .138544 |
| .43 | .1849 | .079507 | 0.6557 | 0.7548 | $\bar{1}$.63347 | 2325.581 | 1.3509 | .145220 |
| .44 | .1936 | .085184 | 0.6633 | 0.7606 | $\bar{1}$.64345 | 2272.727 | 1.3823 | .152053 |
| .45 | .2025 | .091125 | 0.6708 | 0.7663 | $\bar{1}$.65321 | 2222.222 | 1.4137 | .159043 |
| .46 | .2116 | .097336 | 0.6782 | 0.7719 | $\bar{1}$.66276 | 2173.913 | 1.4451 | .166190 |
| .47 | .2209 | .103823 | 0.6856 | 0.7775 | $\bar{1}$.67210 | 2127.660 | 1.4765 | .173494 |
| .48 | .2304 | .110592 | 0.6928 | 0.7830 | $\bar{1}$.68124 | 2083.333 | 1.5080 | .180956 |
| .49 | .2401 | .117649 | 0.7000 | 0.7884 | $\bar{1}$.69020 | 2040.816 | 1.5394 | .188574 |

# FUNCTIONS OF NUMBERS .50 TO .99

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| .50 | .2500 | .125000 | 0.7071 | 0.7937 | $\bar{1}$.69897 | 2000.000 | 1.5708 | .19635 |
| .51 | .2601 | .132651 | 0.7141 | 0.7990 | $\bar{1}$.70757 | 1960.784 | 1.6022 | .20428 |
| .52 | .2704 | .140608 | 0 7211 | 0.8041 | $\bar{1}$.71600 | 1923.077 | 1.6336 | .21237 |
| .53 | .2809 | .148877 | 0.7280 | 0.8093 | $\bar{1}$.72428 | 1886.793 | 1.6650 | .22062 |
| .54 | .2916 | .157464 | 0.7348 | 0.8143 | $\bar{1}$.73239 | 1851.852 | 1.6965 | .22902 |
| .55 | .3025 | .166375 | 0.7416 | 0.8193 | $\bar{1}$.74036 | 1818.182 | 1.7279 | .23758 |
| .56 | .3136 | .175616 | 0.7483 | 0.8243 | $\bar{1}$.74819 | 1785.714 | 1.7593 | .24630 |
| .57 | .3249 | .185193 | 0.7550 | 0.8291 | $\bar{1}$.75587 | 1754.386 | 1.7907 | .25518 |
| .58 | .3364 | .195112 | 0.7616 | 0.8340 | $\bar{1}$.76343 | 1724.138 | 1.8221 | .26401 |
| .59 | .3481 | .205379 | 0.7681 | 0.8387 | $\bar{1}$.77085 | 1694.915 | 1.8535 | .27340 |
| .60 | .3600 | .216000 | 0.7746 | 0.8434 | $\bar{1}$.77815 | 1666.667 | 1.8850 | .28274 |
| .61 | .3721 | .226981 | 0.7810 | 0.8481 | $\bar{1}$.78533 | 1639.344 | 1.9164 | .29225 |
| .62 | .3844 | .238328 | 0.7874 | 0.8527 | $\bar{1}$.79239 | 1612.903 | 1.9478 | .30191 |
| .63 | .3969 | .250047 | 0.7937 | 0.8573 | $\bar{1}$.79934 | 1587.302 | 1.9792 | .31173 |
| .64 | .4096 | .262144 | 0.8000 | 0.8618 | $\bar{1}$.80618 | 1562.500 | 2.0106 | .32170 |
| .65 | .4225 | .274625 | 0.8062 | 0.8662 | $\bar{1}$.81291 | 1538.462 | 2.0420 | .33183 |
| .66 | .4356 | .287496 | 0.8124 | 0.8707 | $\bar{1}$.81954 | 1515.152 | 2.0735 | .34212 |
| .67 | .4489 | .300763 | 0.8185 | 0.8750 | $\bar{1}$.82607 | 1492.537 | 2.1049 | .35257 |
| .68 | .4624 | .314432 | 0.8246 | 0.8794 | $\bar{1}$.83251 | 1470.588 | 2.1363 | .36317 |
| .69 | .4761 | .328509 | 0.8307 | 0.8837 | $\bar{1}$.83885 | 1449.275 | 2.1677 | .37393 |
| .70 | .4900 | .343000 | 0.8367 | 0.8879 | $\bar{1}$.84510 | 1428.571 | 2.1991 | .38485 |
| .71 | .5041 | .357911 | 0.8426 | 0.8921 | $\bar{1}$.85126 | 1408.451 | 2.2305 | .39592 |
| .72 | .5184 | .373248 | 0.8485 | 0.8963 | $\bar{1}$.85733 | 1388.889 | 2.2620 | .40715 |
| .73 | .5329 | .389017 | 0.8544 | 0.9004 | $\bar{1}$.86332 | 1369.863 | 2.2934 | .41854 |
| .74 | .5476 | .405224 | 0.8602 | 0.9045 | $\bar{1}$.86923 | 1351.351 | 2.3248 | .43008 |
| .75 | .5625 | .421875 | 0.8660 | 0.9086 | $\bar{1}$.87506 | 1333.333 | 2.3562 | .44179 |
| .76 | .5776 | .438976 | 0.8718 | 0.9126 | $\bar{1}$.88081 | 1315.790 | 2.3876 | .45365 |
| .77 | .5929 | .456533 | 0.8775 | 0.9166 | $\bar{1}$.88649 | 1298.701 | 2.4190 | .46566 |
| .78 | .6084 | .474552 | 0.8832 | 0.9205 | $\bar{1}$.89209 | 1282.051 | 2.4504 | .47784 |
| .79 | .6241 | .493039 | 0.8888 | 0.9244 | $\bar{1}$.89763 | 1265.823 | 2.4819 | .49017 |
| .80 | .6400 | 512000 | 0.8944 | 0.9283 | $\bar{1}$.90309 | 1250.000 | 2.5133 | .50266 |
| .81 | .6561 | .531441 | 0.9000 | 0.9322 | $\bar{1}$.90849 | 1234.568 | 2.5447 | .51530 |
| .82 | .6724 | .551368 | 0.9055 | 0.9360 | $\bar{1}$.91381 | 1219.512 | 2.5761 | .52810 |
| .83 | .6889 | .571787 | 0.9110 | 0.9398 | $\bar{1}$.91908 | 1204.819 | 2.6075 | .54106 |
| .84 | .7056 | .592704 | 0.9165 | 0.9435 | $\bar{1}$.92428 | 1190.476 | 2.6389 | .55418 |
| .85 | .7225 | .614125 | 0.9220 | 0.9473 | $\bar{1}$.92942 | 1176.471 | 2.6704 | .56745 |
| .86 | .7396 | .636056 | 0.9274 | 0.9510 | $\bar{1}$.93450 | 1162.791 | 2.7018 | .58088 |
| .87 | .7569 | .658503 | 0.9327 | 0.9546 | $\bar{1}$.93952 | 1149.425 | 2.7332 | .59447 |
| .88 | .7744 | .681472 | 0.9381 | 0 9583 | $\bar{1}$.94448 | 1136.364 | 2.7646 | .60821 |
| .89 | .7921 | .704969 | 0.9434 | 0 9619 | $\bar{1}$.94939 | 1123.596 | 2.7960 | .62211 |
| .90 | .8100 | .729000 | 0.9487 | 0.9655 | $\bar{1}$.95424 | 1111.111 | 2.8274 | .63617 |
| .91 | .8281 | .753571 | 0.9539 | 0 9691 | $\bar{1}$.95904 | 1098.901 | 2.8589 | .65039 |
| .92 | .8464 | .778688 | 0.9592 | 0.9726 | $\bar{1}$.96379 | 1086.957 | 2.8903 | .66476 |
| .93 | .8649 | .804357 | 0.9644 | 0.9761 | $\bar{1}$.96848 | 1075.269 | 2.9217 | .67929 |
| .94 | .8836 | .830584 | 0.9695 | 0 9796 | $\bar{1}$.97313 | 1063.830 | 2.9531 | .69398 |
| .95 | .9025 | .857375 | 0.9747 | 0.9830 | $\bar{1}$.97772 | 1052.632 | 2.9845 | .70882 |
| 96 | .9216 | .884736 | 0.9798 | 0.9865 | $\bar{1}$.98227 | 1041.667 | 3.0159 | .72382 |
| .97 | .9409 | .912673 | 0.9849 | 0.9899 | $\bar{1}$.98677 | 1030.928 | 3.0473 | .73898 |
| .98 | .9604 | .941192 | 0.9899 | 0 9933 | $\bar{1}$.99123 | 1020.408 | 3.0788 | .75430 |
| .99 | .9801 | .970299 | 0 9950 | 0 9967 | $\bar{1}$.99564 | 1010.101 | 3.1102 | .76977 |

# 1 TO 49 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 1 | 1 | 1 | 1.0000 | 1.0000 | 0.00000 | 1000.000 | 3.142 | 0.7854 |
| 2 | 4 | 8 | 1.4142 | 1.2599 | 0.30103 | 500.000 | 6.283 | 3.1416 |
| 3 | 9 | 27 | 1.7321 | 1.4422 | 0.47712 | 333.333 | 9.425 | 7.0686 |
| 4 | 16 | 64 | 2.0000 | 1.5874 | 0.60206 | 250.000 | 12.566 | 12.5664 |
| 5 | 25 | 125 | 2.2361 | 1.7100 | 0.69897 | 200.000 | 15.708 | 19.6350 |
| 6 | 36 | 216 | 2.4495 | 1.8171 | 0.77815 | 166.667 | 18.850 | 28.2743 |
| 7 | 49 | 343 | 2.6458 | 1.9129 | 0.84510 | 142.857 | 21.991 | 38.4845 |
| 8 | 64 | 512 | 2.8284 | 2.0000 | 0.90309 | 125.000 | 25.133 | 50.2655 |
| 9 | 81 | 729 | 3.0000 | 2.0801 | 0.95424 | 111.111 | 28.274 | 63.6173 |
| 10 | 100 | 1000 | 3.1623 | 2.1544 | 1.00000 | 100.000 | 31.416 | 78.5398 |
| 11 | 121 | 1331 | 3.3166 | 2.2240 | 1.04139 | 90.9091 | 34.558 | 95.0332 |
| 12 | 144 | 1728 | 3.4641 | 2.2894 | 1.07918 | 83.3333 | 37.699 | 113.097 |
| 13 | 169 | 2197 | 3.6056 | 2.3513 | 1.11394 | 76.9231 | 40.841 | 132.732 |
| 14 | 196 | 2744 | 3.7417 | 2.4101 | 1.14613 | 71.4286 | 43.982 | 153.938 |
| 15 | 225 | 3375 | 3.8730 | 2.4662 | 1.17609 | 66.6667 | 47.124 | 176.715 |
| 16 | 256 | 4096 | 4.0000 | 2.5198 | 1.20412 | 62.5000 | 50.265 | 201.062 |
| 17 | 289 | 4913 | 4 1231 | 2.5713 | 1.23045 | 58.8235 | 53.407 | 226.980 |
| 18 | 324 | 5832 | 4.2426 | 2.6207 | 1.25527 | 55.5556 | 56.549 | 254.469 |
| 19 | 361 | 6859 | 4.3589 | 2.6684 | 1.27875 | 52.6316 | 59.690 | 283.529 |
| 20 | 400 | 8000 | 4.4721 | 2.7144 | 1.30103 | 50.0000 | 62.832 | 314.159 |
| 21 | 441 | 9261 | 4.5826 | 2.7589 | 1.32222 | 47.6190 | 65.973 | 346.361 |
| 22 | 484 | 10648 | 4.6904 | 2.8020 | 1.34242 | 45.4545 | 69.115 | 380.133 |
| 23 | 529 | 12167 | 4.7958 | 2.8439 | 1.36173 | 43.4783 | 72.257 | 415.476 |
| 24 | 576 | 13824 | 4.8990 | 2.8845 | 1.38021 | 41.6667 | 75.398 | 452.389 |
| 25 | 625 | 15625 | 5.0000 | 2.9240 | 1.39794 | 40.0000 | 78.540 | 490.874 |
| 26 | 676 | 17576 | 5.0990 | 2.9625 | 1.41497 | 38.4615 | 81.681 | 530.929 |
| 27 | 729 | 19683 | 5.1962 | 3.0000 | 1.43136 | 37.0370 | 84.823 | 572.555 |
| 28 | 784 | 21952 | 5.2915 | 3.0366 | 1.44716 | 35.7143 | 87.965 | 615.752 |
| 29 | 841 | 24389 | 5.3852 | 3.0723 | 1.46240 | 34.4828 | 91.106 | 660.520 |
| 30 | 900 | 27000 | 5.4772 | 3.1072 | 1.47712 | 33.3333 | 94.248 | 706.858 |
| 31 | 961 | 29791 | 5.5678 | 3.1414 | 1.49136 | 32.2581 | 97.389 | 754.768 |
| 32 | 1024 | 32768 | 5.6569 | 3.1748 | 1.50515 | 31.2500 | 100.531 | 804.248 |
| 33 | 1089 | 35937 | 5.7446 | 3.2075 | 1.51851 | 30.3030 | 103.673 | 855.299 |
| 34 | 1156 | 39304 | 5.8310 | 3 2396 | 1.53148 | 29.4118 | 106.814 | 907.920 |
| 35 | 1225 | 42875 | 5.9161 | 3.2711 | 1.54407 | 28.5714 | 109.956 | 962.113 |
| 36 | 1296 | 46656 | 6.0000 | 3.3019 | 1.55630 | 27.7778 | 113.097 | 1017.88 |
| 37 | 1369 | 50653 | 6.0828 | 3.3322 | 1.56820 | 27.0270 | 116.239 | 1075.21 |
| 38 | 1444 | 54872 | 6.1644 | 3.3620 | 1.57978 | 26.3158 | 119.381 | 1134.11 |
| 39 | 1521 | 59319 | 6.2450 | 3.3912 | 1.59106 | 25.6410 | 122.522 | 1194.59 |
| 40 | 1600 | 64000 | 6.3246 | 3.4200 | 1.60206 | 25.0000 | 125.66 | 1256.64 |
| 41 | 1681 | 68921 | 6.4031 | 3.4482 | 1.61278 | 24.3902 | 128.81 | 1320.25 |
| 42 | 1764 | 74088 | 6.4807 | 3.4760 | 1.62325 | 23.8095 | 131.95 | 1385.44 |
| 43 | 1849 | 79507 | 6.5574 | 3.5034 | 1.63347 | 23.2558 | 135.09 | 1452.20 |
| 44 | 1936 | 85184 | 6.6332 | 3.5303 | 1.64345 | 22.7273 | 138.23 | 1520.53 |
| 45 | 2025 | 91125 | 6.7082 | 3.5569 | 1.65321 | 22.2222 | 141.37 | 1590.43 |
| 46 | 2116 | 97336 | 6.7823 | 3.5830 | 1.66276 | 21.7391 | 144.51 | 1661.90 |
| 47 | 2209 | 103823 | 6.8557 | 3.6088 | 1.67210 | 21.2766 | 147.65 | 1734.94 |
| 48 | 2304 | 110592 | 6.9282 | 3.6342 | 1.68124 | 20.8333 | 150.80 | 1809.56 |
| 49 | 2401 | 117649 | 7.0000 | 3.6593 | 1.69020 | 20.4082 | 153.94 | 1885.74 |

# FUNCTIONS OF NUMBERS 50 TO 99

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 50 | 2500 | 125000 | 7.0711 | 3.6840 | 1.69897 | 20.0000 | 157.08 | 1963.50 |
| 51 | 2601 | 132651 | 7.1414 | 3.7084 | 1.70757 | 19.6078 | 160.22 | 2042.82 |
| 52 | 2704 | 140608 | 7.2111 | 3.7325 | 1.71600 | 19.2308 | 163.36 | 2123.72 |
| 53 | 2809 | 148877 | 7.2801 | 3.7563 | 1.72428 | 18.8679 | 166.50 | 2206.18 |
| 54 | 2916 | 157464 | 7.3485 | 3.7798 | 1.73239 | 18.5185 | 169.65 | 2290.22 |
| 55 | 3025 | 166375 | 7.4162 | 3.8030 | 1.74036 | 18.1818 | 172.79 | 2375.83 |
| 56 | 3136 | 175616 | 7.4833 | 3.8259 | 1.74819 | 17.8571 | 175.93 | 2463.01 |
| 57 | 3249 | 185193 | 7.5498 | 3.8485 | 1.75587 | 17.5439 | 179 07 | 2551.76 |
| 58 | 3364 | 195112 | 7.6158 | 3.8709 | 1.76343 | 17.2414 | 182.21 | 2642.08 |
| 59 | 3481 | 205379 | 7.6811 | 3.8930 | 1.77085 | 16.9492 | 185.35 | 2733.97 |
| 60 | 3600 | 216000 | 7.7460 | 3.9149 | 1.77815 | 16.6667 | 188.50 | 2827.43 |
| 61 | 3721 | 226981 | 7.8102 | 3.9365 | 1.78533 | 16.3934 | 191.64 | 2922.47 |
| 62 | 3844 | 238328 | 7.8740 | 3.9579 | 1.79239 | 16.1290 | 194.78 | 3019.07 |
| 63 | 3969 | 250047 | 7.9373 | 3.9791 | 1.79934 | 15.8730 | 197.92 | 3117.25 |
| 64 | 4096 | 262144 | 8.0000 | 4.0000 | 1.80618 | 15.6250 | 201.06 | 3216.99 |
| 65 | 4225 | 274625 | 8.0623 | 4.0207 | 1.81291 | 15.3846 | 204.20 | 3318.31 |
| 66 | 4356 | 287496 | 8.1240 | 4.0412 | 1.81954 | 15.1515 | 207.35 | 3421.19 |
| 67 | 4489 | 300763 | 8.1854 | 4.0615 | 1.82607 | 14.9254 | 210.49 | 3525.65 |
| 68 | 4624 | 314432 | 8.2462 | 4.0817 | 1.83251 | 14.7059 | 213.63 | 3631.68 |
| 69 | 4761 | 328509 | 8.3066 | 4.1016 | 1.83885 | 14.4928 | 216.77 | 3739.28 |
| 70 | 4900 | 343000 | 8.3666 | 4.1213 | 1.84510 | 14.2857 | 219.91 | 3848.45 |
| 71 | 5041 | 357911 | 8.4261 | 4.1408 | 1.85126 | 14.0845 | 223.05 | 3959.19 |
| 72 | 5184 | 373248 | 8.4853 | 4.1602 | 1.85733 | 13.8889 | 226.19 | 4071.50 |
| 73 | 5329 | 389017 | 8.5440 | 4.1793 | 1.86332 | 13.6986 | 229.34 | 4185.39 |
| 74 | 5476 | 405224 | 8.6023 | 4.1983 | 1.86923 | 13.5135 | 232.48 | 4300.84 |
| 75 | 5625 | 421875 | 8.6603 | 4.2172 | 1.87506 | 13.3333 | 235.62 | 4417.86 |
| 76 | 5776 | 438976 | 8.7178 | 4.2358 | 1.88081 | 13.1579 | 238.76 | 4536.46 |
| 77 | 5929 | 456533 | 8.7750 | 4.2543 | 1.88649 | 12.9870 | 241.90 | 4656.63 |
| 78 | 6084 | 474552 | 8.8318 | 4.2727 | 1.89209 | 12.8205 | 245.04 | 4778.36 |
| 79 | 6241 | 493039 | 8.8882 | 4.2908 | 1.89763 | 12.6582 | 248.19 | 4901.67 |
| 80 | 6400 | 512000 | 8.9443 | 4.3089 | 1.90309 | 12.5000 | 251.33 | 5026.55 |
| 81 | 6561 | 531441 | 9.0000 | 4.3267 | 1.90849 | 12.3457 | 254.47 | 5153.00 |
| 82 | 6724 | 551368 | 9.0554 | 4.3445 | 1.91381 | 12.1951 | 257.61 | 5281.02 |
| 83 | 6889 | 571787 | 9.1104 | 4.3621 | 1.91908 | 12.0482 | 260.75 | 5410.61 |
| 84 | 7056 | 592704 | 9.1652 | 4.3795 | 1.92428 | 11.9048 | 263.89 | 5541.77 |
| 85 | 7225 | 614125 | 9.2195 | 4.3968 | 1.92942 | 11.7647 | 267.04 | 5674.50 |
| 86 | 7396 | 636056 | 9.2736 | 4.4140 | 1.93450 | 11.6279 | 270.18 | 5808.80 |
| 87 | 7569 | 658503 | 9.3274 | 4.4310 | 1.93952 | 11.4943 | 273.32 | 5944.68 |
| 88 | 7744 | 681472 | 9.3808 | 4.4480 | 1.94448 | 11.3636 | 276.46 | 6082.12 |
| 89 | 7921 | 704969 | 9.4340 | 4.4647 | 1.94939 | 11.2360 | 279.60 | 6221.14 |
| 90 | 8100 | 729000 | 9.4868 | 4.4814 | 1.95424 | 11.1111 | 282.74 | 6361.73 |
| 91 | 8281 | 753571 | 9.5394 | 4.4979 | 1.95904 | 10.9890 | 285.88 | 6503.88 |
| 92 | 8464 | 778688 | 9.5917 | 4.5144 | 1.96379 | 10.8696 | 289.03 | 6647.61 |
| 93 | 8649 | 804357 | 9.6437 | 4.5307 | 1.96848 | 10.7527 | 292.17 | 6792.91 |
| 94 | 8836 | 830584 | 9.6954 | 4.5468 | 1.97313 | 10.6383 | 295.31 | 6939.78 |
| 95 | 9025 | 857375 | 9.7468 | 4.5629 | 1.97772 | 10.5263 | 298.45 | 7088.22 |
| 96 | 9216 | 884736 | 9.7980 | 4.5789 | 1.98227 | 10.4167 | 301.59 | 7238.23 |
| 97 | 9409 | 912673 | 9.8489 | 4.5947 | 1.98677 | 10.3093 | 304.73 | 7389.81 |
| 98 | 9604 | 941192 | 9.8995 | 4.6104 | 1.99123 | 10.2041 | 307.88 | 7542.96 |
| 99 | 9801 | 970299 | 9.9499 | 4.6261 | 1.99564 | 10.1010 | 311.02 | 7697.69 |

# 100 TO 149 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 100 | 10000 | 1000000 | 10.0000 | 4.6416 | 2.00000 | 10.0000 | 314.16 | 7853.98 |
| 101 | 10201 | 1030301 | 10.0499 | 4.6570 | 2.00432 | 9.90099 | 317.30 | 8011.85 |
| 102 | 10404 | 1061208 | 10.0995 | 4.6723 | 2.00860 | 9.80392 | 320.44 | 8171.28 |
| 103 | 10609 | 1092727 | 10.1489 | 4.6875 | 2.01284 | 9.70874 | 323.58 | 8332.29 |
| 104 | 10816 | 1124864 | 10.1980 | 4.7027 | 2.01703 | 9.61538 | 326.73 | 8494.87 |
| 105 | 11025 | 1157625 | 10.2470 | 4.7177 | 2.02119 | 9.52381 | 329.87 | 8659.01 |
| 106 | 11236 | 1191016 | 10.2956 | 4.7326 | 2.02531 | 9.43396 | 333.01 | 8824.73 |
| 107 | 11449 | 1225043 | 10.3441 | 4.7475 | 2.02938 | 9.34579 | 336.15 | 8992.02 |
| 108 | 11664 | 1259712 | 10.3923 | 4.7622 | 2.03342 | 9.25926 | 339.29 | 9160.88 |
| 109 | 11881 | 1295029 | 10.4403 | 4.7769 | 2.03743 | 9.17431 | 342.43 | 9331.32 |
| 110 | 12100 | 1331000 | 10.4881 | 4.7914 | 2.04139 | 9.09091 | 345.58 | 9503.32 |
| 111 | 12321 | 1367631 | 10.5357 | 4.8059 | 2.04532 | 9.00901 | 348.72 | 9676.89 |
| 112 | 12544 | 1404928 | 10.5830 | 4.8203 | 2.04922 | 8.92857 | 351.86 | 9852.03 |
| 113 | 12769 | 1442897 | 10.6301 | 4.8346 | 2.05308 | 8.84956 | 355.00 | 10028.7 |
| 114 | 12996 | 1481544 | 10.6771 | 4.8488 | 2.05690 | 8.77193 | 358.14 | 10207.0 |
| 115 | 13225 | 1520875 | 10.7238 | 4.8629 | 2.06070 | 8.69565 | 361.28 | 10386.9 |
| 116 | 13456 | 1560896 | 10.7703 | 4.8770 | 2.06446 | 8.62069 | 364.42 | 10568.3 |
| 117 | 13689 | 1601613 | 10.8167 | 4.8910 | 2.06819 | 8.54701 | 367.57 | 10751.3 |
| 118 | 13924 | 1643032 | 10.8628 | 4.9049 | 2.07188 | 8.47458 | 370.71 | 10935.9 |
| 119 | 14161 | 1685159 | 10.9087 | 4.9187 | 2.07555 | 8.40336 | 373.85 | 11122.0 |
| 120 | 14400 | 1728000 | 10.9545 | 4.9324 | 2.07918 | 8.33333 | 376.99 | 11309.7 |
| 121 | 14641 | 1771561 | 11.0000 | 4.9461 | 2.08279 | 8.26446 | 380.13 | 11499.0 |
| 122 | 14884 | 1815848 | 11.0454 | 4.9597 | 2.08636 | 8.19672 | 383.27 | 11689.9 |
| 123 | 15129 | 1860867 | 11.0905 | 4.9732 | 2.08991 | 8.13008 | 386.42 | 11882.3 |
| 124 | 15376 | 1906624 | 11.1355 | 4.9866 | 2.09342 | 8.06452 | 389.56 | 12076.3 |
| 125 | 15625 | 1953125 | 11.1803 | 5.0000 | 2.09691 | 8.00000 | 392.70 | 12271.8 |
| 126 | 15876 | 2000376 | 11.2250 | 5.0133 | 2.10037 | 7.93651 | 395.84 | 12469.0 |
| 127 | 16129 | 2048383 | 11.2694 | 5.0265 | 2.10380 | 7.87402 | 398.98 | 12667.7 |
| 128 | 16384 | 2097152 | 11.3137 | 5.0397 | 2.10721 | 7.81250 | 402.12 | 12868.0 |
| 129 | 16641 | 2146689 | 11.3578 | 5.0528 | 2.11059 | 7.75194 | 405.27 | 13069.8 |
| 130 | 16900 | 2197000 | 11.4018 | 5.0658 | 2.11394 | 7.69231 | 408.41 | 13273.2 |
| 131 | 17161 | 2248091 | 11.4455 | 5.0788 | 2.11727 | 7.63359 | 411.55 | 13478.2 |
| 132 | 17424 | 2299968 | 11.4891 | 5.0916 | 2.12057 | 7.57576 | 414.69 | 13684.8 |
| 133 | 17689 | 2352637 | 11.5326 | 5.1045 | 2.12385 | 7.51880 | 417.83 | 13892.9 |
| 134 | 17956 | 2406104 | 11.5758 | 5.1172 | 2.12710 | 7.46269 | 420.97 | 14102.6 |
| 135 | 18225 | 2460375 | 11.6190 | 5.1299 | 2.13033 | 7.40741 | 424.12 | 14313.9 |
| 136 | 18496 | 2515456 | 11.6619 | 5.1426 | 2.13354 | 7.35294 | 427.26 | 14526.7 |
| 137 | 18769 | 2571353 | 11.7047 | 5.1551 | 2.13672 | 7.29927 | 430.40 | 14741.1 |
| 138 | 19044 | 2628072 | 11.7473 | 5.1676 | 2.13988 | 7.24638 | 433.54 | 14957.1 |
| 139 | 19321 | 2685619 | 11.7898 | 5.1801 | 2.14301 | 7.19424 | 436.68 | 15174.7 |
| 140 | 19600 | 2744000 | 11.8322 | 5.1925 | 2.14613 | 7.14286 | 439.82 | 15393.8 |
| 141 | 19881 | 2803221 | 11.8743 | 5.2048 | 2.14922 | 7.09220 | 442.96 | 15614.5 |
| 142 | 20164 | 2863288 | 11.9164 | 5.2171 | 2.15229 | 7.04225 | 446.11 | 15836.8 |
| 143 | 20449 | 2924207 | 11.9583 | 5.2293 | 2.15534 | 6.99301 | 449.25 | 16060.6 |
| 144 | 20736 | 2985984 | 12.0000 | 5.2415 | 2.15836 | 6.94444 | 452.39 | 16286.0 |
| 145 | 21025 | 3048625 | 12.0416 | 5.2536 | 2.16137 | 6.89655 | 455.53 | 16513.0 |
| 146 | 21316 | 3112136 | 12.0830 | 5.2656 | 2.16435 | 6.84932 | 458.67 | 16741.5 |
| 147 | 21609 | 3176523 | 12.1244 | 5.2776 | 2.16732 | 6.80272 | 461.81 | 16971.7 |
| 148 | 21904 | 3241792 | 12.1655 | 5.2896 | 2.17026 | 6.75676 | 464.96 | 17203.4 |
| 149 | 22201 | 3307949 | 12.2066 | 5.3015 | 2.17319 | 6.71141 | 468.10 | 17436.6 |

# FUNCTIONS OF NUMBERS 150 TO 199

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 150 | 22500 | 3375000 | 12.2474 | 5.3133 | 2.17609 | 6.66667 | 471.24 | 17671.5 |
| 151 | 22801 | 3442951 | 12.2882 | 5.3251 | 2.17898 | 6.62252 | 474.38 | 17907.9 |
| 152 | 23104 | 3511808 | 12.3288 | 5.3368 | 2.18184 | 6.57895 | 477.52 | 18145.8 |
| 153 | 23409 | 3581577 | 12.3693 | 5.3485 | 2.18469 | 6.53595 | 480.66 | 18385.4 |
| 154 | 23716 | 3652264 | 12.4097 | 5.3601 | 2.18752 | 6.49351 | 483.81 | 18626.5 |
| 155 | 24025 | 3723875 | 12.4499 | 5.3717 | 2.19033 | 6.45161 | 486.95 | 18869.2 |
| 156 | 24336 | 3796416 | 12.4900 | 5.3832 | 2.19312 | 6.41026 | 490.09 | 19113.4 |
| 157 | 24649 | 3869893 | 12.5300 | 5.3947 | 2.19590 | 6.36943 | 493.23 | 19359.3 |
| 158 | 24964 | 3944312 | 12.5698 | 5.4061 | 2.19866 | 6.32911 | 496.37 | 19606.7 |
| 159 | 25281 | 4019679 | 12.6095 | 5.4175 | 2.20140 | 6.28931 | 499.51 | 19855.7 |
| 160 | 25600 | 4096000 | 12.6491 | 5.4288 | 2.20412 | 6.25000 | 502.65 | 20106.2 |
| 161 | 25921 | 4173281 | 12.6886 | 5.4401 | 2.20683 | 6.21118 | 505.80 | 20358.3 |
| 162 | 26244 | 4251528 | 12.7279 | 5.4514 | 2.20952 | 6.17284 | 508.94 | 20612.0 |
| 163 | 26569 | 4330747 | 12.7671 | 5.4626 | 2.21219 | 6.13497 | 512.08 | 20867.2 |
| 164 | 26896 | 4410944 | 12.8062 | 5.4737 | 2.21484 | 6.09756 | 515.22 | 21124.1 |
| 165 | 27225 | 4492125 | 12.8452 | 5.4848 | 2.21748 | 6.06061 | 518.36 | 21382.5 |
| 166 | 27556 | 4574296 | 12.8841 | 5.4959 | 2.22011 | 6.02410 | 521.50 | 21642.4 |
| 167 | 27889 | 4657463 | 12.9228 | 5.5069 | 2.22272 | 5.98802 | 524.65 | 21904.0 |
| 168 | 28224 | 4741632 | 12.9615 | 5.5178 | 2.22531 | 5.95238 | 527.79 | 22167.1 |
| 169 | 28561 | 4826809 | 13.0000 | 5.5288 | 2.22789 | 5.91716 | 530.93 | 22431.8 |
| 170 | 28900 | 4913000 | 13.0384 | 5.5397 | 2.23045 | 5.88235 | 534.07 | 22698.0 |
| 171 | 29241 | 5000211 | 13.0767 | 5.5505 | 2.23300 | 5.84795 | 537.21 | 22965.8 |
| 172 | 29584 | 5088448 | 13.1149 | 5.5613 | 2.23553 | 5.81395 | 540.35 | 23235.2 |
| 173 | 29929 | 5177717 | 13.1529 | 5.5721 | 2.23805 | 5.78035 | 543.50 | 23506.2 |
| 174 | 30276 | 5268024 | 13.1909 | 5.5828 | 2.24055 | 5.74713 | 546.64 | 23778.7 |
| 175 | 30625 | 5359375 | 13.2288 | 5.5934 | 2.24304 | 5.71429 | 549.78 | 24052.8 |
| 176 | 30976 | 5451776 | 13.2665 | 5.6041 | 2.24551 | 5.68182 | 552.92 | 24328.5 |
| 177 | 31329 | 5545233 | 13.3041 | 5.6147 | 2.24797 | 5.64972 | 556.06 | 24605.7 |
| 178 | 31684 | 5639752 | 13.3417 | 5.6252 | 2.25042 | 5.61798 | 559.20 | 24884.6 |
| 179 | 32041 | 5735339 | 13.3791 | 5.6357 | 2.25285 | 5.58659 | 562.35 | 25164.9 |
| 180 | 32400 | 5832000 | 13.4164 | 5.6462 | 2.25527 | 5.55556 | 565.49 | 25446.9 |
| 181 | 32761 | 5929741 | 13.4536 | 5.6567 | 2.25768 | 5.52486 | 568.63 | 25730.4 |
| 182 | 33124 | 6028568 | 13.4907 | 5.6671 | 2.26007 | 5.49451 | 571.77 | 26015.5 |
| 183 | 33489 | 6128487 | 13.5277 | 5.6774 | 2.26245 | 5.46448 | 574.91 | 26302.2 |
| 184 | 33856 | 6229504 | 13.5647 | 5.6877 | 2.26482 | 5.43478 | 578.05 | 26590.4 |
| 185 | 34225 | 6331625 | 13.6015 | 5.6980 | 2.26717 | 5.40541 | 581.19 | 26880.3 |
| 186 | 34596 | 6434856 | 13.6382 | 5.7083 | 2.26951 | 5.37634 | 584.34 | 27171.6 |
| 187 | 34969 | 6539203 | 13.6748 | 5.7185 | 2.27184 | 5.34759 | 587.48 | 27464.6 |
| 188 | 35344 | 6644672 | 13.7113 | 5.7287 | 2.27416 | 5.31915 | 590.62 | 27759.1 |
| 189 | 35721 | 6751269 | 13.7477 | 5.7388 | 2.27646 | 5.29101 | 593.76 | 28055.2 |
| 190 | 36100 | 6859000 | 13.7840 | 5.7489 | 2.27875 | 5.26316 | 596.90 | 28352.9 |
| 191 | 36481 | 6967871 | 13.8203 | 5.7590 | 2.28103 | 5.23560 | 600.04 | 28652.1 |
| 192 | 36864 | 7077888 | 13.8564 | 5.7690 | 2.28330 | 5.20833 | 603.19 | 28952.9 |
| 193 | 37249 | 7189057 | 13.8924 | 5.7790 | 2.28556 | 5.18135 | 606.33 | 29255.3 |
| 194 | 37636 | 7301384 | 13.9284 | 5.7890 | 2.28780 | 5.15464 | 609.47 | 29559.2 |
| 195 | 38025 | 7414875 | 13.9642 | 5.7989 | 2.29003 | 5.12821 | 612.61 | 29864.8 |
| 196 | 38416 | 7529536 | 14.0000 | 5.8088 | 2.29226 | 5.10204 | 615.75 | 30171.9 |
| 197 | 38809 | 7645373 | 14.0357 | 5.8186 | 2.29447 | 5.07614 | 618.89 | 30480.5 |
| 198 | 39204 | 7762392 | 14.0712 | 5.8285 | 2.29667 | 5.05051 | 622.04 | 30790.7 |
| 199 | 39601 | 7880599 | 14.1067 | 5.8383 | 2.29885 | 5.02513 | 625.18 | 31102.6 |

## 200 TO 249 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 200 | 40000 | 8000000 | 14.1421 | 5.8480 | 2.30103 | 5.00000 | 628.32 | 31415.9 |
| 201 | 40401 | 8120601 | 14.1774 | 5.8578 | 2.30320 | 4.97512 | 631.46 | 31730.9 |
| 202 | 40804 | 8242408 | 14.2127 | 5.8675 | 2.30535 | 4.95050 | 634.60 | 32047.4 |
| 203 | 41209 | 8365427 | 14.2478 | 5.8771 | 2.30750 | 4.92611 | 637.74 | 32365.5 |
| 204 | 41616 | 8489664 | 14.2829 | 5.8868 | 2.30963 | 4.90196 | 640.88 | 32685.1 |
| 205 | 42025 | 8615125 | 14.3178 | 5.8964 | 2.31175 | 4.87805 | 644.03 | 33006.4 |
| 206 | 42436 | 8741816 | 14.3527 | 5.9059 | 2.31387 | 4.85437 | 647.17 | 33329.2 |
| 207 | 42849 | 8869743 | 14.3875 | 5.9155 | 2.31597 | 4.83092 | 650.31 | 33653.5 |
| 208 | 43264 | 8998912 | 14.4222 | 5.9250 | 2.31806 | 4.80769 | 653.45 | 33979.5 |
| 209 | 43681 | 9129329 | 14.4568 | 5.9345 | 2.32015 | 4.78469 | 656.59 | 34307.0 |
| 210 | 44100 | 9261000 | 14.4914 | 5.9439 | 2.32222 | 4.76190 | 659.73 | 34636.1 |
| 211 | 44521 | 9393931 | 14.5258 | 5.9533 | 2.32428 | 4.73934 | 662.88 | 34966.7 |
| 212 | 44944 | 9528128 | 14.5602 | 5.9627 | 2.32634 | 4.71698 | 666.02 | 35298.9 |
| 213 | 45369 | 9663597 | 14.5945 | 5.9721 | 2.32838 | 4.69484 | 669.16 | 35632.7 |
| 214 | 45796 | 9800344 | 14.6287 | 5.9814 | 2.33041 | 4.67290 | 672.30 | 35968.1 |
| 215 | 46225 | 9938375 | 14.6629 | 5.9907 | 2.33244 | 4.65116 | 675.44 | 36305.0 |
| 216 | 46656 | 10077696 | 14.6969 | 6.0000 | 2.33445 | 4.62963 | 678.58 | 36643.5 |
| 217 | 47089 | 10218313 | 14.7309 | 6.0092 | 2.33646 | 4.60829 | 681.73 | 36983.6 |
| 218 | 47524 | 10360232 | 14.7648 | 6.0185 | 2.33846 | 4.58716 | 684.87 | 37325.3 |
| 219 | 47961 | 10503459 | 14.7986 | 6.0277 | 2.34044 | 4.56621 | 688.01 | 37668.5 |
| 220 | 48400 | 10648000 | 14.8324 | 6.0368 | 2.34242 | 4.54545 | 691.15 | 38013.3 |
| 221 | 48841 | 10793861 | 14.8661 | 6.0459 | 2.34439 | 4.52489 | 694.29 | 38359.6 |
| 222 | 49284 | 10941048 | 14.8997 | 6.0550 | 2.34635 | 4.50450 | 697.43 | 38707.6 |
| 223 | 49729 | 11089567 | 14.9332 | 6.0641 | 2.34830 | 4.48430 | 700.58 | 39057.1 |
| 224 | 50176 | 11239424 | 14.9666 | 6.0732 | 2.35025 | 4.46429 | 703.72 | 39408.1 |
| 225 | 50625 | 11390625 | 15.0000 | 6.0822 | 2.35218 | 4.44444 | 706.86 | 39760.8 |
| 226 | 51076 | 11543176 | 15.0333 | 6.0912 | 2.35411 | 4.42478 | 710.00 | 40115.0 |
| 227 | 51529 | 11697083 | 15.0665 | 6.1002 | 2.35603 | 4.40529 | 713.14 | 40470.8 |
| 228 | 51984 | 11852352 | 15.0997 | 6.1091 | 2.35793 | 4.38596 | 716.28 | 40828.1 |
| 229 | 52441 | 12008989 | 15.1327 | 6.1180 | 2.35984 | 4.36681 | 719.42 | 41187.1 |
| 230 | 52900 | 12167000 | 15.1658 | 6.1269 | 2.36173 | 4.34783 | 722.57 | 41547.6 |
| 231 | 53361 | 12326391 | 15.1987 | 6.1358 | 2.36361 | 4.32900 | 725.71 | 41909.6 |
| 232 | 53824 | 12487168 | 15.2315 | 6.1446 | 2.36549 | 4.31034 | 728.85 | 42273.3 |
| 233 | 54289 | 12649337 | 15.2643 | 6.1534 | 2.36736 | 4.29185 | 731.99 | 42638.5 |
| 234 | 54756 | 12812904 | 15.2971 | 6.1622 | 2.36922 | 4.27350 | 735.13 | 43005.3 |
| 235 | 55225 | 12977875 | 15.3297 | 6.1710 | 2.37107 | 4.25532 | 738.27 | 43373.6 |
| 236 | 55696 | 13144256 | 15.3623 | 6.1797 | 2.37291 | 4.23729 | 741.42 | 43743.5 |
| 237 | 56169 | 13312053 | 15.3948 | 6.1885 | 2.37475 | 4.21941 | 744.56 | 44115.0 |
| 238 | 56644 | 13481272 | 15.4272 | 6.1972 | 2.37658 | 4.20168 | 747.70 | 44488.1 |
| 239 | 57121 | 13651919 | 15.4596 | 6.2058 | 2.37840 | 4.18410 | 750.84 | 44862.7 |
| 240 | 57600 | 13824000 | 15.4919 | 6.2145 | 2.38021 | 4.16667 | 753.98 | 45238.9 |
| 241 | 58081 | 13997521 | 15.5242 | 6.2231 | 2.38202 | 4.14938 | 757.12 | 45616.7 |
| 242 | 58564 | 14172488 | 15.5563 | 6.2317 | 2.38382 | 4.13223 | 760.27 | 45996.1 |
| 243 | 59049 | 14348907 | 15.5885 | 6.2403 | 2.38561 | 4.11523 | 763.41 | 46377.0 |
| 244 | 59536 | 14526784 | 15.6205 | 6.2488 | 2.38739 | 4.09836 | 766.55 | 46759.5 |
| 245 | 60025 | 14706125 | 15.6525 | 6.2573 | 2.38917 | 4.08163 | 769.69 | 47143.5 |
| 246 | 60516 | 14886936 | 15.6844 | 6.2658 | 2.39094 | 4.06504 | 772.83 | 47529.2 |
| 247 | 61009 | 15069223 | 15.7162 | 6.2743 | 2.39270 | 4.04858 | 775.97 | 47916.4 |
| 248 | 61504 | 15252992 | 15.7480 | 6.2828 | 2.39445 | 4.03226 | 779.12 | 48305.1 |
| 249 | 62001 | 15438249 | 15.7797 | 6.2912 | 2.39620 | 4.01606 | 782.26 | 48695.5 |

# FUNCTIONS OF NUMBERS 250 TO 299

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 250 | 62500 | 15625000 | 15.8114 | 6.2996 | 2.39794 | 4.00000 | 785.40 | 49087.4 |
| 251 | 63001 | 15813251 | 15.8430 | 6.3080 | 2.39967 | 3.98406 | 788.54 | 49480.9 |
| 252 | 63504 | 16003008 | 15.8745 | 6.3164 | 2.40140 | 3.96825 | 791.68 | 49875.9 |
| 253 | 64009 | 16194277 | 15.9060 | 6.3247 | 2.40312 | 3.95257 | 794.82 | 50272.6 |
| 254 | 64516 | 16387064 | 15.9374 | 6.3330 | 2.40483 | 3.93701 | 797.96 | 50670.7 |
| 255 | 65025 | 16581375 | 15.9687 | 6.3413 | 2.40654 | 3.92157 | 801.11 | 51070.5 |
| 256 | 65536 | 16777216 | 16.0000 | 6.3496 | 2.40824 | 3.90625 | 804.25 | 51471.9 |
| 257 | 66049 | 16974593 | 16.0312 | 6.3579 | 2.40993 | 3.89105 | 807.39 | 51874.8 |
| 258 | 66564 | 17173512 | 16.0624 | 6.3661 | 2.41162 | 3.87597 | 810.53 | 52279.2 |
| 259 | 67081 | 17373979 | 16.0935 | 6.3743 | 2.41330 | 3.86100 | 813.67 | 52685.3 |
| 260 | 67600 | 17576000 | 16.1245 | 6.3825 | 2.41497 | 3.84615 | 816.81 | 53092.9 |
| 261 | 68121 | 17779581 | 16.1555 | 6.3907 | 2.41664 | 3.83142 | 819.96 | 53502.1 |
| 262 | 68644 | 17984728 | 16.1864 | 6.3988 | 2.41830 | 3.81679 | 823.10 | 53912.9 |
| 263 | 69169 | 18191447 | 16.2173 | 6.4070 | 2.41996 | 3.80228 | 826.24 | 54325.2 |
| 264 | 69696 | 18399744 | 16.2481 | 6.4151 | 2.42160 | 3.78788 | 829.38 | 54739.1 |
| 265 | 70225 | 18609625 | 16.2788 | 6.4232 | 2.42325 | 3.77358 | 832.52 | 55154.6 |
| 266 | 70756 | 18821096 | 16.3095 | 6.4312 | 2.42488 | 3.75940 | 835.66 | 55571.6 |
| 267 | 71289 | 19034163 | 16.3401 | 6.4393 | 2.42651 | 3.74532 | 838.81 | 55990.2 |
| 268 | 71824 | 19248832 | 16.3707 | 6.4473 | 2.42813 | 3.73134 | 841.95 | 56410.4 |
| 269 | 72361 | 19465109 | 16.4012 | 6.4553 | 2.42975 | 3.71747 | 845.09 | 56832.2 |
| 270 | 72900 | 19683000 | 16.4317 | 6.4633 | 2.43136 | 3.70370 | 848.23 | 57255.5 |
| 271 | 73441 | 19902511 | 16.4621 | 6.4713 | 2.43297 | 3.69004 | 851.37 | 57680.4 |
| 272 | 73984 | 20123648 | 16.4924 | 6.4792 | 2.43457 | 3.67647 | 854.51 | 58106.9 |
| 273 | 74529 | 20346417 | 16.5227 | 6.4872 | 2.43616 | 3.66300 | 857.65 | 58534.9 |
| 274 | 75076 | 20570824 | 16.5529 | 6.4951 | 2.43775 | 3.64964 | 860.80 | 58964.6 |
| 275 | 75625 | 20796875 | 16.5831 | 6.5030 | 2.43933 | 3.63636 | 863.94 | 59395.7 |
| 276 | 76176 | 21024576 | 16.6132 | 6.5108 | 2.44091 | 3.62319 | 867.08 | 59828.5 |
| 277 | 76729 | 21253933 | 16.6433 | 6.5187 | 2.44248 | 3.61011 | 870.22 | 60262.8 |
| 278 | 77284 | 21484952 | 16.6733 | 6.5265 | 2.44404 | 3.59712 | 873.36 | 60698.7 |
| 279 | 77841 | 21717639 | 16.7033 | 6.5343 | 2.44560 | 3.58423 | 876.50 | 61136.2 |
| 280 | 78400 | 21952000 | 16.7332 | 6.5421 | 2.44716 | 3.57143 | 879.65 | 61575.2 |
| 281 | 78961 | 22188041 | 16.7631 | 6.5499 | 2.44871 | 3.55872 | 882.79 | 62015.8 |
| 282 | 79524 | 22425768 | 16.7929 | 6.5577 | 2.45025 | 3.54610 | 885.93 | 62458.0 |
| 283 | 80089 | 22665187 | 16.8226 | 6.5654 | 2.45179 | 3.53357 | 889.07 | 62901.8 |
| 284 | 80656 | 22906304 | 16.8523 | 6.5731 | 2.45332 | 3.52113 | 892.21 | 63347.1 |
| 285 | 81225 | 23149125 | 16.8819 | 6.5808 | 2.45484 | 3.50877 | 895.35 | 63794.0 |
| 286 | 81796 | 23393656 | 16.9115 | 6.5885 | 2.45637 | 3.49650 | 898.50 | 64242.4 |
| 287 | 82369 | 23639903 | 16.9411 | 6.5962 | 2.45788 | 3.48432 | 901.64 | 64692.5 |
| 288 | 82944 | 23887872 | 16.9706 | 6.6039 | 2.45939 | 3.47222 | 904.78 | 65144.1 |
| 289 | 83521 | 24137569 | 17.0000 | 6.6115 | 2.46090 | 3.46021 | 907.92 | 65597.2 |
| 290 | 84100 | 24389000 | 17.0294 | 6.6191 | 2.46240 | 3.44828 | 911.06 | 66052.0 |
| 291 | 84681 | 24642171 | 17.0587 | 6.6267 | 2.46389 | 3.43643 | 914.20 | 66508.3 |
| 292 | 85264 | 24897088 | 17.0880 | 6.6343 | 2.46538 | 3.42466 | 917.35 | 66966.2 |
| 293 | 85849 | 25153757 | 17.1172 | 6.6419 | 2.46687 | 3.41297 | 920.49 | 67425.6 |
| 294 | 86436 | 25412184 | 17.1464 | 6.6494 | 2.46835 | 3.40136 | 923.63 | 67886.7 |
| 295 | 87025 | 25672375 | 17.1756 | 6.6569 | 2.46982 | 3.38983 | 926.77 | 68349.3 |
| 296 | 87616 | 25934336 | 17.2047 | 6.6644 | 2.47129 | 3.37838 | 929.91 | 68813.4 |
| 297 | 88209 | 26198073 | 17.2337 | 6.6719 | 2.47276 | 3.36700 | 933.05 | 69279.2 |
| 298 | 88804 | 26463592 | 17.2627 | 6.6794 | 2.47422 | 3.35570 | 936.19 | 69746.5 |
| 299 | 89401 | 26730899 | 17.2916 | 6.6869 | 2.47567 | 3.34448 | 939.34 | 70215.4 |

# 300 TO 349 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 300 | 90000 | 27000000 | 17.3205 | 6.6943 | 2.47712 | 3.33333 | 942.48 | 70685.8 |
| 301 | 90601 | 27270901 | 17.3494 | 6.7018 | 2.47857 | 3.32226 | 945.62 | 71157.9 |
| 302 | 91204 | 27543608 | 17.3781 | 6.7092 | 2.48001 | 3.31126 | 948.76 | 71631.5 |
| 303 | 91809 | 27818127 | 17.4069 | 6.7166 | 2.48144 | 3.30033 | 951.90 | 72106.6 |
| 304 | 92416 | 28094464 | 17.4356 | 6.7240 | 2.48287 | 3.28947 | 955.04 | 72583.4 |
| 305 | 93025 | 28372625 | 17.4642 | 6.7313 | 2.48430 | 3.27869 | 958.19 | 73061.7 |
| 306 | 93636 | 28652616 | 17.4929 | 6.7387 | 2.48572 | 3.26797 | 961.33 | 73541.5 |
| 307 | 94249 | 28934443 | 17.5214 | 6.7460 | 2.48714 | 3.25733 | 964.47 | 74023.0 |
| 308 | 94864 | 29218112 | 17.5499 | 6.7533 | 2.48855 | 3.24675 | 967.61 | 74506.0 |
| 309 | 95481 | 29503629 | 17.5784 | 6.7606 | 2.48996 | 3.23625 | 970.75 | 74990.6 |
| 310 | 96100 | 29791000 | 17.6068 | 6.7679 | 2.49136 | 3.22581 | 973.89 | 75476.8 |
| 311 | 96721 | 30080231 | 17.6352 | 6.7752 | 2.49276 | 3.21543 | 977.04 | 75964.5 |
| 312 | 97344 | 30371328 | 17.6635 | 6.7824 | 2.49415 | 3.20513 | 980.18 | 76453.8 |
| 313 | 97969 | 30664297 | 17.6918 | 6.7897 | 2.49554 | 3.19489 | 983.32 | 76944.7 |
| 314 | 98596 | 30959144 | 17.7200 | 6.7969 | 2.49693 | 3.18471 | 986.46 | 77437.1 |
| 315 | 99225 | 31255875 | 17.7482 | 6.8041 | 2.49831 | 3.17460 | 989.60 | 77931.1 |
| 316 | 99856 | 31554496 | 17.7764 | 6.8113 | 2.49969 | 3.16456 | 992.74 | 78426.7 |
| 317 | 100489 | 31855013 | 17.8045 | 6.8185 | 2.50106 | 3.15457 | 995.88 | 78923.9 |
| 318 | 101124 | 32157432 | 17.8326 | 6.8256 | 2.50243 | 3.14465 | 999.03 | 79422.6 |
| 319 | 101761 | 32461759 | 17.8606 | 6.8328 | 2.50379 | 3.13480 | 1002.2 | 79922.9 |
| 320 | 102400 | 32768000 | 17.8885 | 6.8399 | 2.50515 | 3.12500 | 1005.3 | 80424.8 |
| 321 | 103041 | 33076161 | 17.9165 | 6.8470 | 2.50651 | 3.11526 | 1008.5 | 80928.2 |
| 322 | 103684 | 33386248 | 17.9444 | 6.8541 | 2.50786 | 3.10559 | 1011.6 | 81433.2 |
| 323 | 104329 | 33698267 | 17.9722 | 6.8612 | 2.50920 | 3.09598 | 1014.7 | 81939.8 |
| 324 | 104976 | 34012224 | 18.0000 | 6.8683 | 2.51055 | 3.08642 | 1017.9 | 82448.0 |
| 325 | 105625 | 34328125 | 18.0278 | 6.8753 | 2.51188 | 3.07692 | 1021.0 | 82957.7 |
| 326 | 106276 | 34645976 | 18.0555 | 6.8824 | 2.51322 | 3.06749 | 1024.2 | 83469.0 |
| 327 | 106929 | 34965783 | 18.0831 | 6.8894 | 2.51455 | 3.05810 | 1027.3 | 83981.8 |
| 328 | 107584 | 35287552 | 18.1108 | 6.8964 | 2.51587 | 3.04878 | 1030.4 | 84496.3 |
| 329 | 108241 | 35611289 | 18.1384 | 6.9034 | 2.51720 | 3.03951 | 1033.6 | 85012.3 |
| 330 | 108900 | 35937000 | 18.1659 | 6.9104 | 2.51851 | 3.03030 | 1036.7 | 85529.9 |
| 331 | 109561 | 36264691 | 18.1934 | 6.9174 | 2.51983 | 3.02115 | 1039.9 | 86049.0 |
| 332 | 110224 | 36594368 | 18.2209 | 6.9244 | 2.52114 | 3.01205 | 1043.0 | 86569.7 |
| 333 | 110889 | 36926037 | 18.2483 | 6.9313 | 2.52244 | 3.00300 | 1046.2 | 87092.0 |
| 334 | 111556 | 37259704 | 18.2757 | 6.9382 | 2.52375 | 2.99401 | 1049.3 | 87615.9 |
| 335 | 112225 | 37595375 | 18.3030 | 6.9451 | 2.52504 | 2.98507 | 1052.4 | 88141.3 |
| 336 | 112896 | 37933056 | 18.3303 | 6.9521 | 2.52634 | 2.97619 | 1055.6 | 88668.3 |
| 337 | 113569 | 38272753 | 18.3576 | 6.9589 | 2.52763 | 2.96736 | 1058.7 | 89196.9 |
| 338 | 114244 | 38614472 | 18.3848 | 6.9658 | 2.52892 | 2.95858 | 1061.9 | 89727.0 |
| 339 | 114921 | 38958219 | 18.4120 | 6.9727 | 2.53020 | 2.94985 | 1065.0 | 90258.7 |
| 340 | 115600 | 39304000 | 18.4391 | 6.9795 | 2.53148 | 2.94118 | 1068.1 | 90792.0 |
| 341 | 116281 | 39651821 | 18.4662 | 6.9864 | 2.53275 | 2.93255 | 1071.3 | 91326.9 |
| 342 | 116964 | 40001688 | 18.4932 | 6.9932 | 2.53403 | 2.92398 | 1074.4 | 91863.3 |
| 343 | 117649 | 40353607 | 18.5203 | 7.0000 | 2.53529 | 2.91545 | 1077.6 | 92401.3 |
| 344 | 118336 | 40707584 | 18.5472 | 7.0068 | 2.53656 | 2.90698 | 1080.7 | 92940.9 |
| 345 | 119025 | 41063625 | 18.5742 | 7.0136 | 2.53782 | 2.89855 | 1083.8 | 93482.0 |
| 346 | 119716 | 41421736 | 18.6011 | 7.0203 | 2.53908 | 2.89017 | 1087.0 | 94024.7 |
| 347 | 120409 | 41781923 | 18.6279 | 7.0271 | 2.54033 | 2.88184 | 1090.1 | 94569.0 |
| 348 | 121104 | 42144192 | 18.6548 | 7.0338 | 2.54158 | 2.87356 | 1093.3 | 95114.9 |
| 349 | 121801 | 42508549 | 18.6815 | 7.0406 | 2.54283 | 2.86533 | 1096.4 | 95662.3 |

# FUNCTIONS OF NUMBERS 350 TO 399

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 350 | 122500 | 42875000 | 18.7083 | 7.0473 | 2.54407 | 2.85714 | 1099.6 | 96211.3 |
| 351 | 123201 | 43243551 | 18.7350 | 7.0540 | 2.54531 | 2.84900 | 1102.7 | 96761.8 |
| 352 | 123904 | 43614208 | 18.7617 | 7.0607 | 2.54654 | 2.84091 | 1105.8 | 97314.0 |
| 353 | 124609 | 43986977 | 18.7883 | 7.0674 | 2.54777 | 2.83286 | 1109.0 | 97867.7 |
| 354 | 125316 | 44361864 | 18.8149 | 7.0740 | 2.54900 | 2.82486 | 1112.1 | 98423.0 |
| 355 | 126025 | 44738875 | 18.8414 | 7.0807 | 2.55023 | 2.81690 | 1115.3 | 98979.8 |
| 356 | 126736 | 45118016 | 18.8680 | 7.0873 | 2.55145 | 2.80899 | 1118.4 | 99538.2 |
| 357 | 127449 | 45499293 | 18.8944 | 7.0940 | 2.55267 | 2.80112 | 1121.5 | 100098 |
| 358 | 128164 | 45882712 | 18.9209 | 7.1006 | 2.55388 | 2.79330 | 1124.7 | 100660 |
| 359 | 128881 | 46268279 | 18.9473 | 7.1072 | 2.55509 | 2.78552 | 1127.8 | 101223 |
| 360 | 129600 | 46656000 | 18.9737 | 7.1138 | 2.55630 | 2.77778 | 1131.0 | 101788 |
| 361 | 130321 | 47045881 | 19.0000 | 7.1204 | 2.55751 | 2.77008 | 1134.1 | 102354 |
| 362 | 131044 | 47437928 | 19.0263 | 7.1269 | 2.55871 | 2.76243 | 1137.3 | 102922 |
| 363 | 131769 | 47832147 | 19.0526 | 7.1335 | 2.55991 | 2.75482 | 1140.4 | 103491 |
| 364 | 132496 | 48228544 | 19.0788 | 7.1400 | 2.56110 | 2.74725 | 1143.5 | 104062 |
| 365 | 133225 | 48627125 | 19.1050 | 7.1466 | 2.56229 | 2.73973 | 1146.7 | 104635 |
| 366 | 133956 | 49027896 | 19.1311 | 7.1531 | 2.56348 | 2.73224 | 1149.8 | 105209 |
| 367 | 134689 | 49430863 | 19.1572 | 7.1596 | 2.56467 | 2.72480 | 1153.0 | 105785 |
| 368 | 135424 | 49836032 | 19.1833 | 7.1661 | 2.56585 | 2.71739 | 1156.1 | 106362 |
| 369 | 136161 | 50243409 | 19.2094 | 7.1726 | 2.56703 | 2.71003 | 1159.2 | 106941 |
| 370 | 136900 | 50653000 | 19.2354 | 7.1791 | 2.56820 | 2.70270 | 1162.4 | 107521 |
| 371 | 137641 | 51064811 | 19.2614 | 7.1855 | 2.56937 | 2.69542 | 1165.5 | 108103 |
| 372 | 138384 | 51478848 | 19.2873 | 7.1920 | 2.57054 | 2.68817 | 1168.7 | 108687 |
| 373 | 139129 | 51895117 | 19.3132 | 7.1984 | 2.57171 | 2.68097 | 1171.8 | 109272 |
| 374 | 139876 | 52313624 | 19.3391 | 7.2048 | 2.57287 | 2.67380 | 1175.0 | 109858 |
| 375 | 140625 | 52734375 | 19.3649 | 7.2112 | 2.57403 | 2.66667 | 1178.1 | 110447 |
| 376 | 141376 | 53157376 | 19.3907 | 7.2177 | 2.57519 | 2.65957 | 1181.2 | 111036 |
| 377 | 142129 | 53582633 | 19.4165 | 7.2240 | 2.57634 | 2.65252 | 1184.4 | 111628 |
| 378 | 142884 | 54010152 | 19.4422 | 7.2304 | 2.57749 | 2.64550 | 1187.5 | 112221 |
| 379 | 143641 | 54439939 | 19.4679 | 7.2368 | 2.57864 | 2.63852 | 1190.7 | 112815 |
| 380 | 144400 | 54872000 | 19.4936 | 7.2432 | 2.57978 | 2.63158 | 1193.8 | 113411 |
| 381 | 145161 | 55306341 | 19.5192 | 7.2495 | 2.58093 | 2.62467 | 1196.9 | 114009 |
| 382 | 145924 | 55742968 | 19.5448 | 7.2558 | 2.58206 | 2.61780 | 1200.1 | 114608 |
| 383 | 146689 | 56181887 | 19.5704 | 7.2622 | 2.58320 | 2.61097 | 1203.2 | 115209 |
| 384 | 147456 | 56623104 | 19.5959 | 7.2685 | 2.58433 | 2.60417 | 1206.4 | 115812 |
| 385 | 148225 | 57066625 | 19.6214 | 7.2748 | 2.58546 | 2.59740 | 1209.5 | 116416 |
| 386 | 148996 | 57512456 | 19.6469 | 7.2811 | 2.58659 | 2.59067 | 1212.7 | 117021 |
| 387 | 149769 | 57960603 | 19.6723 | 7.2874 | 2.58771 | 2.58398 | 1215.8 | 117628 |
| 388 | 150544 | 58411072 | 19.6977 | 7.2936 | 2.58883 | 2.57732 | 1218.9 | 118237 |
| 389 | 151321 | 58863869 | 19.7231 | 7.2999 | 2.58995 | 2.57069 | 1222.1 | 118847 |
| 390 | 152100 | 59319000 | 19.7484 | 7.3061 | 2.59106 | 2.56410 | 1225.2 | 119459 |
| 391 | 152881 | 59776471 | 19.7737 | 7.3124 | 2.59218 | 2.55754 | 1228.4 | 120072 |
| 392 | 153664 | 60236288 | 19.7990 | 7.3186 | 2.59329 | 2.55102 | 1231.5 | 120687 |
| 393 | 154449 | 60698457 | 19.8242 | 7.3248 | 2.59439 | 2.54453 | 1234.6 | 121304 |
| 394 | 155236 | 61162984 | 19.8494 | 7.3310 | 2.59550 | 2.53807 | 1237.8 | 121922 |
| 395 | 156025 | 61629875 | 19.8746 | 7.3372 | 2.59660 | 2.53165 | 1240.9 | 122542 |
| 396 | 156816 | 62099136 | 19.8997 | 7.3434 | 2.59770 | 2.52525 | 1244.1 | 123163 |
| 397 | 157609 | 62570773 | 19.9249 | 7.3496 | 2.59879 | 2.51889 | 1247.2 | 123786 |
| 398 | 158404 | 63044792 | 19.9499 | 7.3558 | 2.59988 | 2.51256 | 1250.4 | 124410 |
| 399 | 159201 | 63521199 | 19.9750 | 7.3619 | 2.60097 | 2.50627 | 1253.5 | 125036 |

# 400 TO 449 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 400 | 160000 | 64000000 | 20.0000 | 7.3681 | 2.60206 | 2.50000 | 1256.6 | 125664 |
| 401 | 160801 | 64481201 | 20.0250 | 7.3742 | 2.60314 | 2.49377 | 1259.8 | 126293 |
| 402 | 161604 | 64964808 | 20.0499 | 7.3803 | 2.60423 | 2.48756 | 1262.9 | 126923 |
| 403 | 162409 | 65450827 | 20.0749 | 7.3864 | 2.60531 | 2.48139 | 1266.1 | 127556 |
| 404 | 163216 | 65939264 | 20.0998 | 7.3925 | 2.60638 | 2.47525 | 1269.2 | 128190 |
| 405 | 164025 | 66430125 | 20.1246 | 7.3986 | 2.60746 | 2.46914 | 1272.3 | 128825 |
| 406 | 164836 | 66923416 | 20.1494 | 7.4047 | 2.60853 | 2.46305 | 1275.5 | 129462 |
| 407 | 165649 | 67419143 | 20.1742 | 7.4108 | 2.60959 | 2.45700 | 1278.6 | 130100 |
| 408 | 166464 | 67917312 | 20.1990 | 7.4169 | 2.61066 | 2.45098 | 1281.8 | 130741 |
| 409 | 167281 | 68417929 | 20.2237 | 7.4229 | 2.61172 | 2.44499 | 1284.9 | 131382 |
| 410 | 168100 | 68921000 | 20.2485 | 7.4290 | 2.61278 | 2.43902 | 1288.1 | 132025 |
| 411 | 168921 | 69426531 | 20.2731 | 7.4350 | 2.61384 | 2.43309 | 1291.2 | 132670 |
| 412 | 169744 | 69934528 | 20.2978 | 7.4410 | 2.61490 | 2.42718 | 1294.3 | 133317 |
| 413 | 170569 | 70444997 | 20.3224 | 7.4470 | 2.61595 | 2.42131 | 1297.5 | 133965 |
| 414 | 171396 | 70957944 | 20.3470 | 7.4530 | 2.61700 | 2.41546 | 1300.6 | 134614 |
| 415 | 172225 | 71473375 | 20.3715 | 7.4590 | 2.61805 | 2.40964 | 1303.8 | 135265 |
| 416 | 173056 | 71991296 | 20.3961 | 7.4650 | 2.61909 | 2.40385 | 1306.9 | 135918 |
| 417 | 173889 | 72511713 | 20.4206 | 7.4710 | 2.62014 | 2.39808 | 1310.0 | 136572 |
| 418 | 174724 | 73034632 | 20.4450 | 7.4770 | 2.62118 | 2.39234 | 1313.2 | 137228 |
| 419 | 175561 | 73560059 | 20.4695 | 7.4829 | 2.62221 | 2.38663 | 1316.3 | 137885 |
| 420 | 176400 | 74088000 | 20.4939 | 7.4889 | 2.62325 | 2.38095 | 1319.5 | 138544 |
| 421 | 177241 | 74618461 | 20.5183 | 7.4948 | 2.62428 | 2.37530 | 1322.6 | 139205 |
| 422 | 178084 | 75151448 | 20.5426 | 7.5007 | 2.62531 | 2.36967 | 1325.8 | 139867 |
| 423 | 178929 | 75686967 | 20.5670 | 7.5067 | 2.62634 | 2.36407 | 1328.9 | 140531 |
| 424 | 179776 | 76225024 | 20.5913 | 7.5126 | 2.62737 | 2.35849 | 1332.0 | 141196 |
| 425 | 180625 | 76765625 | 20.6155 | 7.5185 | 2.62839 | 2.35294 | 1335.2 | 141863 |
| 426 | 181476 | 77308776 | 20.6398 | 7.5244 | 2.62941 | 2.34742 | 1338.3 | 142531 |
| 427 | 182329 | 77854483 | 20.6640 | 7.5302 | 2.63043 | 2.34192 | 1341.5 | 143201 |
| 428 | 183184 | 78402752 | 20.6882 | 7.5361 | 2.63144 | 2.33645 | 1344.6 | 143872 |
| 429 | 184041 | 78953589 | 20.7123 | 7.5420 | 2.63246 | 2.33100 | 1347.7 | 144545 |
| 430 | 184900 | 79507000 | 20.7364 | 7.5478 | 2.63347 | 2.32558 | 1350.9 | 145220 |
| 431 | 185761 | 80062991 | 20.7605 | 7.5537 | 2.63448 | 2.32019 | 1354.0 | 145896 |
| 432 | 186624 | 80621568 | 20.7846 | 7.5595 | 2.63548 | 2.31481 | 1357.2 | 146574 |
| 433 | 187489 | 81182737 | 20.8087 | 7.5654 | 2.63649 | 2.30947 | 1360.3 | 147254 |
| 434 | 188356 | 81746504 | 20.8327 | 7.5712 | 2.63749 | 2.30415 | 1363.5 | 147934 |
| 435 | 189225 | 82312875 | 20.8567 | 7.5770 | 2.63849 | 2.29885 | 1366.6 | 148617 |
| 436 | 190096 | 82881856 | 20.8806 | 7.5828 | 2.63949 | 2.29358 | 1369.7 | 149301 |
| 437 | 190969 | 83453453 | 20.9045 | 7.5886 | 2.64048 | 2.28833 | 1372.9 | 149987 |
| 438 | 191844 | 84027672 | 20.9284 | 7.5944 | 2.64147 | 2.28311 | 1376.0 | 150674 |
| 439 | 192721 | 84604519 | 20.9523 | 7 6001 | 2.64246 | 2.27790 | 1379.2 | 151363 |
| 440 | 193600 | 85184000 | 20.9762 | 7.6059 | 2.64345 | 2.27273 | 1382.3 | 152053 |
| 441 | 194481 | 85766121 | 21.0000 | 7.6117 | 2.64444 | 2.26757 | 1385.4 | 152745 |
| 442 | 195364 | 86350888 | 21.0238 | 7.6174 | 2.64542 | 2.26244 | 1388.6 | 153439 |
| 443 | 196249 | 86938307 | 21.0476 | 7.6232 | 2.64640 | 2.25734 | 1391.7 | 154134 |
| 444 | 197136 | 87528384 | 21.0713 | 7 6289 | 2 64738 | 2.25225 | 1394.9 | 154830 |
| 445 | 198025 | 88121125 | 21.0950 | 7.6346 | 2.64836 | 2.24719 | 1398.0 | 155528 |
| 446 | 198916 | 88716536 | 21.1187 | 7.6403 | 2.64933 | 2.24215 | 1401.2 | 156228 |
| 447 | 199809 | 89314623 | 21 1424 | 7.6460 | 2.65031 | 2.23714 | 1404.3 | 156930 |
| 448 | 200704 | 89915392 | 21.1660 | 7.6517 | 2.65128 | 2.23214 | 1407.4 | 157633 |
| 449 | 201601 | 90518849 | 21.1896 | 7.6574 | 2.65225 | 2.22717 | 1410.6 | 158337 |

# FUNCTIONS OF NUMBERS 450 TO 499

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 450 | 202500 | 91125000 | 21.2132 | 7.6631 | 2.65321 | 2.22222 | 1413.7 | 159043 |
| 451 | 203401 | 91733851 | 21.2368 | 7.6688 | 2.65418 | 2.21729 | 1416.9 | 159751 |
| 452 | 204304 | 92345408 | 21.2603 | 7.6744 | 2.65514 | 2.21239 | 1420.0 | 160460 |
| 453 | 205209 | 92959677 | 21.2838 | 7.6801 | 2.65610 | 2.20751 | 1423.1 | 161171 |
| 454 | 206116 | 93576664 | 21.3073 | 7.6857 | 2.65706 | 2.20264 | 1426.3 | 161883 |
| 455 | 207025 | 94196375 | 21.3307 | 7.6914 | 2.65801 | 2.19780 | 1429.4 | 162597 |
| 456 | 207936 | 94818816 | 21.3542 | 7.6970 | 2.65896 | 2.19298 | 1432.6 | 163313 |
| 457 | 208849 | 95443993 | 21.3776 | 7.7026 | 2.65992 | 2.18818 | 1435.7 | 164030 |
| 458 | 209764 | 96071912 | 21.4009 | 7.7082 | 2.66087 | 2.18341 | 1438.8 | 164748 |
| 459 | 210681 | 96702579 | 21.4243 | 7.7138 | 2.66181 | 2.17865 | 1442.0 | 165468 |
| 460 | 211600 | 97336000 | 21.4476 | 7.7194 | 2.66276 | 2.17391 | 1445.1 | 166190 |
| 461 | 212521 | 97972181 | 21.4709 | 7.7250 | 2.66370 | 2.16920 | 1448.3 | 166914 |
| 462 | 213444 | 98611128 | 21.4942 | 7.7306 | 2.66464 | 2.16450 | 1451.4 | 167639 |
| 463 | 214369 | 99252847 | 21.5174 | 7.7362 | 2.66558 | 2.15983 | 1454.6 | 168365 |
| 464 | 215296 | 99897344 | 21.5407 | 7.7418 | 2.66652 | 2.15517 | 1457.7 | 169093 |
| 465 | 216225 | 100544625 | 21.5639 | 7.7473 | 2.66745 | 2.15054 | 1460.8 | 169823 |
| 466 | 217156 | 101194696 | 21.5870 | 7.7529 | 2.66839 | 2.14592 | 1464.0 | 170554 |
| 467 | 218089 | 101847563 | 21.6102 | 7.7584 | 2.66932 | 2.14133 | 1467.1 | 171287 |
| 468 | 219024 | 102503232 | 21.6333 | 7.7639 | 2.67025 | 2.13675 | 1470.3 | 172021 |
| 469 | 219961 | 103161709 | 21.6564 | 7.7695 | 2.67117 | 2.13220 | 1473.4 | 172757 |
| 470 | 220900 | 103823000 | 21.6795 | 7.7750 | 2.67210 | 2.12766 | 1476.5 | 173494 |
| 471 | 221841 | 104487111 | 21.7025 | 7.7805 | 2.67302 | 2.12314 | 1479.7 | 174234 |
| 472 | 222784 | 105154048 | 21.7256 | 7.7860 | 2.67394 | 2.11864 | 1482.8 | 174974 |
| 473 | 223729 | 105823817 | 21.7486 | 7.7915 | 2.67486 | 2.11416 | 1486.0 | 175716 |
| 474 | 224676 | 106496424 | 21.7715 | 7.7970 | 2.67578 | 2.10970 | 1489.1 | 176460 |
| 475 | 225625 | 107171875 | 21.7945 | 7.8025 | 2.67669 | 2.10526 | 1492.3 | 177205 |
| 476 | 226576 | 107850176 | 21.8174 | 7.8079 | 2.67761 | 2.10084 | 1495.4 | 177952 |
| 477 | 227529 | 108531333 | 21.8403 | 7.8134 | 2.67852 | 2.09644 | 1498.5 | 178701 |
| 478 | 228484 | 109215352 | 21.8632 | 7.8188 | 2.67943 | 2.09205 | 1501.7 | 179451 |
| 479 | 229441 | 109902239 | 21.8861 | 7.8243 | 2.68034 | 2.08768 | 1504.8 | 180203 |
| 480 | 230400 | 110592000 | 21.9089 | 7.8297 | 2.68124 | 2.08333 | 1508.0 | 180956 |
| 481 | 231361 | 111284641 | 21.9317 | 7.8352 | 2.68215 | 2.07900 | 1511.1 | 181711 |
| 482 | 232324 | 111980168 | 21.9545 | 7.8406 | 2.68305 | 2.07469 | 1514.2 | 182467 |
| 483 | 233289 | 112678587 | 21.9773 | 7.8460 | 2.68395 | 2.07039 | 1517.4 | 183225 |
| 484 | 234256 | 113379904 | 22.0000 | 7.8514 | 2.68485 | 2.06612 | 1520.5 | 183984 |
| 485 | 235225 | 114084125 | 22.0227 | 7.8568 | 2.68574 | 2.06186 | 1523.7 | 184745 |
| 486 | 236196 | 114791256 | 22.0454 | 7.8622 | 2.68664 | 2.05761 | 1526.8 | 185508 |
| 487 | 237169 | 115501303 | 22.0681 | 7.8676 | 2.68753 | 2.05339 | 1530.0 | 186272 |
| 488 | 238144 | 116214272 | 22.0907 | 7.8730 | 2.68842 | 2.04918 | 1533.1 | 187038 |
| 489 | 239121 | 116930169 | 22.1133 | 7.8784 | 2.68931 | 2.04499 | 1536.2 | 187805 |
| 490 | 240100 | 117649000 | 22.1359 | 7.8837 | 2.69020 | 2.04082 | 1539.4 | 188574 |
| 491 | 241081 | 118370771 | 22.1585 | 7.8891 | 2.69108 | 2.03666 | 1542.5 | 189345 |
| 492 | 242064 | 119095488 | 22.1811 | 7.8944 | 2.69197 | 2.03252 | 1545.7 | 190117 |
| 493 | 243049 | 119823157 | 22.2036 | 7.8998 | 2.69285 | 2.02840 | 1548.8 | 190890 |
| 494 | 244036 | 120553784 | 22.2261 | 7.9051 | 2.69373 | 2.02429 | 1551.9 | 191665 |
| 495 | 245025 | 121287375 | 22.2486 | 7.9105 | 2.69461 | 2.02020 | 1555.1 | 192442 |
| 496 | 246016 | 122023936 | 22.2711 | 7.9158 | 2.69548 | 2.01613 | 1558.2 | 193221 |
| 497 | 247009 | 122763473 | 22.2935 | 7.9211 | 2.69636 | 2.01207 | 1561.4 | 194000 |
| 498 | 248004 | 123505992 | 22.3159 | 7.9264 | 2.69723 | 2.00803 | 1564.5 | 194782 |
| 499 | 249001 | 124251499 | 22.3383 | 7.9317 | 2.69810 | 2.00401 | 1567.7 | 195565 |

## 500 TO 549 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 500 | 250000 | 125000000 | 22.3607 | 7.9370 | 2.69897 | 2.00000 | 1570.8 | 196350 |
| 501 | 251001 | 125751501 | 22.3830 | 7.9423 | 2.69984 | 1.99601 | 1573.9 | 197136 |
| 502 | 252004 | 126506008 | 22.4054 | 7.9476 | 2.70070 | 1.99203 | 1577.1 | 197923 |
| 503 | 253009 | 127263527 | 22.4277 | 7.9528 | 2.70157 | 1.98807 | 1580.2 | 198713 |
| 504 | 254016 | 128024064 | 22.4499 | 7.9581 | 2.70243 | 1.98413 | 1583.4 | 199504 |
| 505 | 255025 | 128787625 | 22.4722 | 7.9634 | 2.70329 | 1.98020 | 1586.5 | 200296 |
| 506 | 256036 | 129554216 | 22.4944 | 7.9686 | 2.70415 | 1.97628 | 1589.6 | 201090 |
| 507 | 257049 | 130323843 | 22.5167 | 7.9739 | 2.70501 | 1.97239 | 1592.8 | 201886 |
| 508 | 258064 | 131096512 | 22.5389 | 7.9791 | 2.70586 | 1.96850 | 1595.9 | 202683 |
| 509 | 259081 | 131872229 | 22.5610 | 7.9843 | 2.70672 | 1.96464 | 1599.1 | 203482 |
| 510 | 260100 | 132651000 | 22.5832 | 7.9896 | 2.70757 | 1.96078 | 1602.2 | 204282 |
| 511 | 261121 | 133432831 | 22.6053 | 7.9948 | 2.70842 | 1.95695 | 1605.4 | 205084 |
| 512 | 262144 | 134217728 | 22.6274 | 8.0000 | 2.70927 | 1.95312 | 1608.5 | 205887 |
| 513 | 263169 | 135005697 | 22.6495 | 8.0052 | 2.71012 | 1.94932 | 1611.6 | 206692 |
| 514 | 264196 | 135796744 | 22.6716 | 8.0104 | 2.71096 | 1.94553 | 1614.8 | 207499 |
| 515 | 265225 | 136590875 | 22.6936 | 8.0156 | 2.71181 | 1.94175 | 1617.9 | 208307 |
| 516 | 266256 | 137388096 | 22.7156 | 8.0208 | 2.71265 | 1.93798 | 1621.1 | 209117 |
| 517 | 267289 | 138188413 | 22.7376 | 8.0260 | 2.71349 | 1.93424 | 1624.2 | 209928 |
| 518 | 268324 | 138991832 | 22.7596 | 8.0311 | 2.71433 | 1.93050 | 1627.3 | 210741 |
| 519 | 269361 | 139798359 | 22.7816 | 8.0363 | 2.71517 | 1.92678 | 1630.5 | 211556 |
| 520 | 270400 | 140608000 | 22.8035 | 8.0415 | 2.71600 | 1.92308 | 1633.6 | 212372 |
| 521 | 271441 | 141420761 | 22.8254 | 8.0466 | 2.71684 | 1.91939 | 1636.8 | 213189 |
| 522 | 272484 | 142236648 | 22.8473 | 8.0517 | 2.71767 | 1.91571 | 1639.9 | 214008 |
| 523 | 273529 | 143055667 | 22.8692 | 8.0569 | 2.71850 | 1.91205 | 1643.1 | 214829 |
| 524 | 274576 | 143877824 | 22.8910 | 8.0620 | 2.71933 | 1.90840 | 1646.2 | 215651 |
| 525 | 275625 | 144703125 | 22.9129 | 8.0671 | 2.72016 | 1.90476 | 1649.3 | 216475 |
| 526 | 276676 | 145531576 | 22.9347 | 8.0723 | 2.72099 | 1.90114 | 1652.5 | 217301 |
| 527 | 277729 | 146363183 | 22.9565 | 8.0774 | 2.72181 | 1.89753 | 1655.6 | 218128 |
| 528 | 278784 | 147197952 | 22.9783 | 8.0825 | 2.72263 | 1.89394 | 1658.8 | 218956 |
| 529 | 279841 | 148035889 | 23.0000 | 8.0876 | 2.72346 | 1.89036 | 1661.9 | 219787 |
| 530 | 280900 | 148877000 | 23.0217 | 8.0927 | 2.72428 | 1.88679 | 1665.0 | 220618 |
| 531 | 281961 | 149721291 | 23.0434 | 8.0978 | 2.72509 | 1.88324 | 1668.2 | 221452 |
| 532 | 283024 | 150568768 | 23.0651 | 8.1028 | 2.72591 | 1.87970 | 1671.3 | 222287 |
| 533 | 284089 | 151419437 | 23.0868 | 8.1079 | 2.72673 | 1.87617 | 1674.5 | 223123 |
| 534 | 285156 | 152273304 | 23.1084 | 8.1130 | 2.72754 | 1.87266 | 1677.6 | 223961 |
| 535 | 286225 | 153130375 | 23.1301 | 8.1180 | 2.72835 | 1.86916 | 1680.8 | 224801 |
| 536 | 287296 | 153990656 | 23.1517 | 8.1231 | 2.72916 | 1.86567 | 1683.9 | 225642 |
| 537 | 288369 | 154854153 | 23.1733 | 8.1281 | 2.72997 | 1.86220 | 1687.0 | 226484 |
| 538 | 289444 | 155720872 | 23.1948 | 8.1332 | 2.73078 | 1.85874 | 1690.2 | 227329 |
| 539 | 290521 | 156590819 | 23.2164 | 8.1382 | 2.73159 | 1.85529 | 1693.3 | 228175 |
| 540 | 291600 | 157464000 | 23.2379 | 8.1433 | 2.73239 | 1.85185 | 1696.5 | 229022 |
| 541 | 292681 | 158340421 | 23.2594 | 8.1483 | 2.73320 | 1.84843 | 1699.6 | 229871 |
| 542 | 293764 | 159220088 | 23.2809 | 8.1533 | 2.73400 | 1.84502 | 1702.7 | 230722 |
| 543 | 294849 | 160103007 | 23.3024 | 8.1583 | 2.73480 | 1.84162 | 1705.9 | 231574 |
| 544 | 295936 | 160989184 | 23.3238 | 8.1633 | 2.73560 | 1.83824 | 1709.0 | 232428 |
| 545 | 297025 | 161878625 | 23.3452 | 8.1683 | 2.73640 | 1.83486 | 1712.2 | 233283 |
| 546 | 298116 | 162771336 | 23.3666 | 8.1733 | 2.73719 | 1.83150 | 1715.3 | 234140 |
| 547 | 299209 | 163667323 | 23.3880 | 8.1783 | 2.73799 | 1.82815 | 1718.5 | 234998 |
| 548 | 300304 | 164566592 | 23.4094 | 8.1833 | 2.73878 | 1.82482 | 1721.6 | 235858 |
| 549 | 301401 | 165469149 | 23.4307 | 8.1882 | 2.73957 | 1.82149 | 1724.7 | 236720 |

# FUNCTIONS OF NUMBERS 550 TO 599

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 550 | 302500 | 166375000 | 23.4521 | 8.1932 | 2.74036 | 1.81818 | 1727.9 | 237583 |
| 551 | 303601 | 167284151 | 23.4734 | 8.1982 | 2.74115 | 1.81488 | 1731.0 | 238448 |
| 552 | 304704 | 168196608 | 23.4947 | 8.2031 | 2.74194 | 1.81159 | 1734.2 | 239314 |
| 553 | 305809 | 169112377 | 23.5160 | 8.2081 | 2.74273 | 1.80832 | 1737.3 | 240182 |
| 554 | 306916 | 170031464 | 23.5372 | 8.2130 | 2.74351 | 1.80505 | 1740.4 | 241051 |
| 555 | 308025 | 170953875 | 23.5584 | 8.2180 | 2.74429 | 1.80180 | 1743.6 | 241922 |
| 556 | 309136 | 171879616 | 23.5797 | 8.2229 | 2.74507 | 1.79856 | 1746.7 | 242795 |
| 557 | 310249 | 172808693 | 23.6008 | 8.2278 | 2.74586 | 1.79533 | 1749.9 | 243669 |
| 558 | 311364 | 173741112 | 23.6220 | 8.2327 | 2.74663 | 1.79211 | 1753.0 | 244545 |
| 559 | 312481 | 174676879 | 23.6432 | 8.2377 | 2.74741 | 1.78891 | 1756.2 | 245422 |
| 560 | 313600 | 175616000 | 23.6643 | 8.2426 | 2.74819 | 1.78571 | 1759.3 | 246301 |
| 561 | 314721 | 176558481 | 23.6854 | 8.2475 | 2.74896 | 1.78253 | 1762.4 | 247181 |
| 562 | 315844 | 177504328 | 23.7065 | 8.2524 | 2.74974 | 1.77936 | 1765.6 | 248063 |
| 563 | 316969 | 178453547 | 23.7276 | 8.2573 | 2.75051 | 1.77620 | 1768.7 | 248947 |
| 564 | 318096 | 179406144 | 23.7487 | 8.2621 | 2.75128 | 1.77305 | 1771.9 | 249832 |
| 565 | 319225 | 180362125 | 23.7697 | 8.2670 | 2.75205 | 1.76991 | 1775.0 | 250719 |
| 566 | 320356 | 181321496 | 23.7908 | 8.2719 | 2.75282 | 1.76678 | 1778.1 | 251607 |
| 567 | 321489 | 182284263 | 23.8118 | 8.2768 | 2.75358 | 1.76367 | 1781.3 | 252497 |
| 568 | 322624 | 183250432 | 23.8328 | 8.2816 | 2.75435 | 1.76056 | 1784.4 | 253388 |
| 569 | 323761 | 184220009 | 23.8537 | 8.2865 | 2.75511 | 1.75747 | 1787.6 | 254281 |
| 570 | 324900 | 185193000 | 23.8747 | 8.2913 | 2.75587 | 1.75439 | 1790.7 | 255176 |
| 571 | 326041 | 186169411 | 23.8956 | 8.2962 | 2.75664 | 1.75131 | 1793.8 | 256072 |
| 572 | 327184 | 187149248 | 23.9165 | 8.3010 | 2.75740 | 1.74825 | 1797.0 | 256970 |
| 573 | 328329 | 188132517 | 23.9374 | 8.3059 | 2.75815 | 1.74520 | 1800.1 | 257869 |
| 574 | 329476 | 189119224 | 23.9583 | 8.3107 | 2.75891 | 1.74216 | 1803.3 | 258770 |
| 575 | 330625 | 190109375 | 23.9792 | 8.3155 | 2.75967 | 1.73913 | 1806.4 | 259672 |
| 576 | 331776 | 191102976 | 24.0000 | 8.3203 | 2.76042 | 1.73611 | 1809.6 | 260576 |
| 577 | 332929 | 192100033 | 24.0208 | 8.3251 | 2.76118 | 1.73310 | 1812.7 | 261482 |
| 578 | 334084 | 193100552 | 24.0416 | 8.3300 | 2.76193 | 1.73010 | 1815.8 | 262389 |
| 579 | 335241 | 194104539 | 24.0624 | 8.3348 | 2.76268 | 1.72712 | 1819.0 | 263298 |
| 580 | 336400 | 195112000 | 24.0832 | 8.3396 | 2.76343 | 1.72414 | 1822.1 | 264208 |
| 581 | 337561 | 196122941 | 24.1039 | 8.3443 | 2.76418 | 1.72117 | 1825.3 | 265120 |
| 582 | 338724 | 197137368 | 24.1247 | 8.3491 | 2.76492 | 1.71821 | 1828.4 | 266033 |
| 583 | 339889 | 198155287 | 24.1454 | 8.3539 | 2.76567 | 1.71527 | 1831.6 | 266948 |
| 584 | 341056 | 199176704 | 24.1661 | 8.3587 | 2.76641 | 1.71233 | 1834.7 | 267865 |
| 585 | 342225 | 200201625 | 24.1868 | 8.3634 | 2.76716 | 1.70940 | 1837.8 | 268783 |
| 586 | 343396 | 201230056 | 24.2074 | 8.3682 | 2.76790 | 1.70648 | 1841.0 | 269703 |
| 587 | 344569 | 202262003 | 24.2281 | 8.3730 | 2.76864 | 1.70358 | 1844.1 | 270624 |
| 588 | 345744 | 203297472 | 24.2487 | 8.3777 | 2.76938 | 1.70068 | 1847.3 | 271547 |
| 589 | 346921 | 204336469 | 24.2693 | 8.3825 | 2.77012 | 1.69779 | 1850.4 | 272471 |
| 590 | 348100 | 205379000 | 24.2899 | 8.3872 | 2.77085 | 1.69492 | 1853.5 | 273397 |
| 591 | 349281 | 206425071 | 24.3105 | 8.3919 | 2.77159 | 1.69205 | 1856.7 | 274325 |
| 592 | 350464 | 207474688 | 24.3311 | 8.3967 | 2.77232 | 1.68919 | 1859.8 | 275254 |
| 593 | 351649 | 208527857 | 24.3516 | 8.4014 | 2.77305 | 1.68634 | 1863.0 | 276184 |
| 594 | 352836 | 209584584 | 24.3721 | 8.4061 | 2.77379 | 1.68350 | 1866.1 | 277117 |
| 595 | 354025 | 210644875 | 24.3926 | 8.4108 | 2.77452 | 1.68067 | 1869.2 | 278051 |
| 596 | 355216 | 211708736 | 24.4131 | 8.4155 | 2.77525 | 1.67785 | 1872.4 | 278986 |
| 597 | 356409 | 212776173 | 24.4336 | 8.4202 | 2.77597 | 1.67504 | 1875.5 | 279923 |
| 598 | 357604 | 213847192 | 24.4540 | 8.4249 | 2.77670 | 1.67224 | 1878.7 | 280862 |
| 599 | 358801 | 214921799 | 24.4745 | 8.4296 | 2.77743 | 1.66945 | 1881.8 | 281802 |

# 600 TO 649 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 600 | 360000 | 216000000 | 24.4949 | 8.4343 | 2.77815 | 1.66667 | 1885.0 | 282743 |
| 601 | 361201 | 217081801 | 24.5153 | 8.4390 | 2.77887 | 1.66389 | 1888.1 | 283687 |
| 602 | 362404 | 218167208 | 24.5357 | 8.4437 | 2.77960 | 1.66113 | 1891.2 | 284631 |
| 603 | 363609 | 219256227 | 24.5561 | 8.4484 | 2.78032 | 1.65837 | 1894.4 | 285578 |
| 604 | 364816 | 220348864 | 24.5764 | 8.4530 | 2.78104 | 1.65563 | 1897.5 | 286526 |
| 605 | 366025 | 221445125 | 24.5967 | 8.4577 | 2.78176 | 1.65289 | 1900.7 | 287475 |
| 606 | 367236 | 222545016 | 24.6171 | 8.4623 | 2.78247 | 1.65017 | 1903.8 | 288426 |
| 607 | 368449 | 223648543 | 24.6374 | 8.4670 | 2.78319 | 1.64745 | 1906.9 | 289379 |
| 608 | 369664 | 224755712 | 24.6577 | 8.4716 | 2.78390 | 1.64474 | 1910.1 | 290333 |
| 609 | 370881 | 225866529 | 24.6779 | 8.4763 | 2.78462 | 1.64204 | 1913.2 | 291289 |
| 610 | 372100 | 226981000 | 24.6982 | 8.4809 | 2.78533 | 1.63934 | 1916.4 | 292247 |
| 611 | 373321 | 228099131 | 24.7184 | 8.4856 | 2.78604 | 1.63666 | 1919.5 | 293206 |
| 612 | 374544 | 229220928 | 24.7386 | 8.4902 | 2.78675 | 1.63399 | 1922.7 | 294166 |
| 613 | 375769 | 230346397 | 24.7588 | 8.4948 | 2.78746 | 1.63132 | 1925.8 | 295128 |
| 614 | 376996 | 231475544 | 24.7790 | 8.4994 | 2.78817 | 1.62866 | 1928.9 | 296092 |
| 615 | 378225 | 232608375 | 24.7992 | 8.5040 | 2.78888 | 1.62602 | 1932.1 | 297057 |
| 616 | 379456 | 233744896 | 24.8193 | 8.5086 | 2.78958 | 1.62338 | 1935.2 | 298024 |
| 617 | 380689 | 234885113 | 24.8395 | 8.5132 | 2.79029 | 1.62075 | 1938.4 | 298992 |
| 618 | 381924 | 236029032 | 24.8596 | 8.5178 | 2.79099 | 1.61812 | 1941.5 | 299962 |
| 619 | 383161 | 237176659 | 24.8797 | 8.5224 | 2.79169 | 1.61551 | 1944.6 | 300934 |
| 620 | 384400 | 238328000 | 24.8998 | 8.5270 | 2.79239 | 1.61290 | 1947.8 | 301907 |
| 621 | 385641 | 239483061 | 24.9199 | 8.5316 | 2.79309 | 1.61031 | 1950.9 | 302882 |
| 622 | 386884 | 240641848 | 24.9399 | 8.5362 | 2.79379 | 1.60772 | 1954.1 | 303858 |
| 623 | 388129 | 241804367 | 24.9600 | 8.5408 | 2.79449 | 1.60514 | 1957.2 | 304836 |
| 624 | 389376 | 242970624 | 24.9800 | 8.5453 | 2.79518 | 1.60256 | 1960.4 | 305815 |
| 625 | 390625 | 244140625 | 25.0000 | 8.5499 | 2.79588 | 1.60000 | 1963.5 | 306796 |
| 626 | 391876 | 245314376 | 25.0200 | 8.5544 | 2.79657 | 1.59744 | 1966.6 | 307779 |
| 627 | 393129 | 246491883 | 25.0400 | 8.5590 | 2.79727 | 1.59490 | 1969.8 | 308763 |
| 628 | 394384 | 247673152 | 25.0599 | 8.5635 | 2.79796 | 1.59236 | 1972.9 | 309748 |
| 629 | 395641 | 248858189 | 25.0799 | 8.5681 | 2.79865 | 1.58983 | 1976.1 | 310736 |
| 630 | 396900 | 250047000 | 25.0998 | 8.5726 | 2.79934 | 1.58730 | 1979.2 | 311725 |
| 631 | 398161 | 251239591 | 25.1197 | 8.5772 | 2.80003 | 1.58479 | 1982.3 | 312715 |
| 632 | 399424 | 252435968 | 25.1396 | 8.5817 | 2.80072 | 1.58228 | 1985.5 | 313707 |
| 633 | 400689 | 253636137 | 25.1595 | 8.5862 | 2.80140 | 1.57978 | 1988.6 | 314700 |
| 634 | 401956 | 254840104 | 25.1794 | 8.5907 | 2.80209 | 1.57729 | 1991.8 | 315696 |
| 635 | 403225 | 256047875 | 25.1992 | 8.5952 | 2.80277 | 1.57480 | 1994.9 | 316692 |
| 636 | 404496 | 257259456 | 25.2190 | 8.5997 | 2.80346 | 1.57233 | 1998.1 | 317690 |
| 637 | 405769 | 258474853 | 25.2389 | 8.6043 | 2.80414 | 1.56986 | 2001.2 | 318690 |
| 638 | 407044 | 259694072 | 25.2587 | 8.6088 | 2.80482 | 1.56740 | 2004.3 | 319692 |
| 639 | 408321 | 260917119 | 25.2784 | 8.6132 | 2.80550 | 1.56495 | 2007 5 | 320695 |
| 640 | 409600 | 262144000 | 25.2982 | 8.6177 | 2.80618 | 1.56250 | 2010.6 | 321699 |
| 641 | 410881 | 263374721 | 25.3180 | 8.6222 | 2.80686 | 1.56006 | 2013.8 | 322705 |
| 642 | 412164 | 264609288 | 25.3377 | 8.6267 | 2.80754 | 1.55763 | 2016 9 | 323713 |
| 643 | 413449 | 265847707 | 25.3574 | 8.6312 | 2.80821 | 1.55521 | 2020.0 | 324722 |
| 644 | 414736 | 267089984 | 25.3772 | 8.6357 | 2.80889 | 1.55280 | 2023.2 | 325733 |
| 645 | 416025 | 268336125 | 25.3969 | 8.6401 | 2.80956 | 1.55039 | 2026.3 | 326745 |
| 646 | 417316 | 269586136 | 25.4165 | 8.6446 | 2.81023 | 1.54799 | 2029.5 | 327759 |
| 647 | 418609 | 270840023 | 25.4362 | 8.6490 | 2.81090 | 1.54560 | 2032.6 | 328775 |
| 648 | 419904 | 272097792 | 25.4558 | 8.6535 | 2.81158 | 1.54321 | 2035.8 | 329792 |
| 649 | 421201 | 273359449 | 25.4755 | 8.6579 | 2.81224 | 1.54083 | 2038.9 | 330810 |

# FUNCTIONS OF NUMBERS 650 TO 699

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 650 | 422500 | 274625000 | 25.4951 | 8.6624 | 2.81291 | 1.53846 | 2042.0 | 331831 |
| 651 | 423801 | 275894451 | 25.5147 | 8.6668 | 2.81358 | 1.53610 | 2045.2 | 332853 |
| 652 | 425104 | 277167808 | 25.5343 | 8.6713 | 2.81425 | 1.53374 | 2048.3 | 333876 |
| 653 | 426409 | 278445077 | 25.5539 | 8.6757 | 2.81491 | 1.53139 | 2051.5 | 334901 |
| 654 | 427716 | 279726264 | 25.5734 | 8.6801 | 2.81558 | 1.52905 | 2054.6 | 335927 |
| 655 | 429025 | 281011375 | 25.5930 | 8.6845 | 2.81624 | 1.52672 | 2057.7 | 336955 |
| 656 | 430336 | 282300416 | 25.6125 | 8.6890 | 2.81690 | 1.52439 | 2060.9 | 337985 |
| 657 | 431649 | 283593393 | 25.6320 | 8.6934 | 2.81757 | 1.52207 | 2064.0 | 339016 |
| 658 | 432964 | 284890312 | 25.6515 | 8.6978 | 2.81823 | 1.51976 | 2067.2 | 340049 |
| 659 | 434281 | 286191179 | 25.6710 | 8.7022 | 2.81889 | 1.51745 | 2070.3 | 341084 |
| 660 | 435600 | 287496000 | 25.6905 | 8.7066 | 2.81954 | 1.51515 | 2073.5 | 342119 |
| 661 | 436921 | 288804781 | 25.7099 | 8.7110 | 2.82020 | 1.51286 | 2076.6 | 343157 |
| 662 | 438244 | 290117528 | 25.7294 | 8.7154 | 2.82086 | 1.51057 | 2079.7 | 344196 |
| 663 | 439569 | 291434247 | 25.7488 | 8.7198 | 2.82151 | 1.50830 | 2082.9 | 345237 |
| 664 | 440896 | 292754944 | 25.7682 | 8.7241 | 2.82217 | 1.50602 | 2086.0 | 346279 |
| 665 | 442225 | 294079625 | 25.7876 | 8.7285 | 2.82282 | 1.50376 | 2089.2 | 347323 |
| 666 | 443556 | 295408296 | 25.8070 | 8.7329 | 2.82347 | 1.50150 | 2092.3 | 348368 |
| 667 | 444889 | 296740963 | 25.8263 | 8.7373 | 2.82413 | 1.49925 | 2095.4 | 349415 |
| 668 | 446224 | 298077632 | 25.8457 | 8.7416 | 2.82478 | 1.49701 | 2098.6 | 350464 |
| 669 | 447561 | 299418309 | 25.8650 | 8.7460 | 2.82543 | 1.49477 | 2101.7 | 351514 |
| 670 | 448900 | 300763000 | 25.8844 | 8.7503 | 2.82607 | 1.49254 | 2104.9 | 352565 |
| 671 | 450241 | 302111711 | 25.9037 | 8.7547 | 2.82672 | 1.49031 | 2108.0 | 353618 |
| 672 | 451584 | 303464448 | 25.9230 | 8.7590 | 2.82737 | 1.48810 | 2111.2 | 354673 |
| 673 | 452929 | 304821217 | 25.9422 | 8.7634 | 2.82082 | 1.48588 | 2114.3 | 355730 |
| 674 | 454276 | 306182024 | 25.9615 | 8.7677 | 2.82866 | 1.48368 | 2117.4 | 356788 |
| 675 | 455625 | 307546875 | 25.9808 | 8.7721 | 2.82930 | 1.48148 | 2120.6 | 357847 |
| 676 | 456976 | 308915776 | 26.0000 | 8.7764 | 2.82995 | 1.47929 | 2123.7 | 358908 |
| 677 | 458329 | 310288733 | 26.0192 | 8.7807 | 2.83059 | 1.47710 | 2126.9 | 359971 |
| 678 | 459684 | 311665752 | 26.0384 | 8.7850 | 2.83123 | 1.47493 | 2130.0 | 361035 |
| 679 | 461041 | 313046839 | 26.0576 | 8.7893 | 2.83187 | 1.47275 | 2133.1 | 362101 |
| 680 | 462400 | 314432000 | 26.0768 | 8.7937 | 2.83251 | 1.47059 | 2136.3 | 363168 |
| 681 | 463761 | 315821241 | 26.0960 | 8.7980 | 2.83315 | 1.46843 | 2139.4 | 364237 |
| 682 | 465124 | 317214568 | 26.1151 | 8.8023 | 2.83378 | 1.46628 | 2142.6 | 365308 |
| 683 | 466489 | 318611987 | 26 1343 | 8.8066 | 2.83442 | 1.46413 | 2145.7 | 366380 |
| 684 | 467856 | 320013504 | 26.1534 | 8.8109 | 2.83506 | 1.46199 | 2148.8 | 367453 |
| 685 | 469225 | 321419125 | 26 1725 | 8.8152 | 2.83569 | 1.45985 | 2152.0 | 368528 |
| 686 | 470596 | 322828856 | 26.1916 | 8.8194 | 2.83632 | 1.45773 | 2155.1 | 369605 |
| 687 | 471969 | 324242703 | 26.2107 | 8.8237 | 2.83696 | 1.45560 | 2158.3 | 370684 |
| 688 | 473344 | 325660672 | 26.2298 | 8.8280 | 2.83759 | 1.45349 | 2161.4 | 371764 |
| 689 | 474721 | 327082769 | 26.2488 | 8.8323 | 2.83822 | 1.45138 | 2164.6 | 372845 |
| 690 | 476100 | 328509000 | 26.2679 | 8.8366 | 2.83885 | 1.44928 | 2167.7 | 373928 |
| 691 | 477481 | 329939371 | 26 2869 | 8 8408 | 2.83948 | 1.44718 | 2170.8 | 375013 |
| 692 | 478864 | 331373888 | 26.3059 | 8.8451 | 2.84011 | 1.44509 | 2174.0 | 376099 |
| 693 | 480249 | 332812557 | 26.3249 | 8.8493 | 2.84073 | 1.44300 | 2177.1 | 377187 |
| 694 | 481636 | 334255384 | 26 3439 | 8 8536 | 2.84136 | 1.44092 | 2180.3 | 378276 |
| 695 | 483025 | 335702375 | 26.3629 | 8.8578 | 2 84198 | 1.43885 | 2183.4 | 379367 |
| 696 | 484416 | 337153536 | 26 3818 | 8.8621 | 2.84261 | 1 43678 | 2186.5 | 380459 |
| 697 | 485809 | 338608873 | 26 4008 | 8.8663 | 2.84323 | 1.43472 | 2189.7 | 381553 |
| 698 | 487204 | 340068392 | 26.4197 | 8.8706 | 2 84386 | 1 43266 | 2192.8 | 382649 |
| 699 | 488601 | 341532099 | 26 4386 | 8 8748 | 2.84448 | 1.43062 | 2196.0 | 383746 |

# 700 TO 749 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 700 | 490000 | 343000000 | 26.4575 | 8.8790 | 2.84510 | 1.42857 | 2199.1 | 384845 |
| 701 | 491401 | 344472101 | 26.4764 | 8.8833 | 2.84572 | 1.42653 | 2202.3 | 385945 |
| 702 | 492804 | 345948408 | 26.4953 | 8.8875 | 2.84634 | 1.42450 | 2205.4 | 387047 |
| 703 | 494209 | 347428927 | 26.5141 | 8.8917 | 2.84696 | 1.42248 | 2208.5 | 388151 |
| 704 | 495616 | 348913664 | 26.5330 | 8.8959 | 2.84757 | 1.42045 | 2211.7 | 389256 |
| 705 | 497025 | 350402625 | 26.5518 | 8.9001 | 2.84819 | 1.41844 | 2214.8 | 390363 |
| 706 | 498436 | 351895816 | 26.5707 | 8.9043 | 2.84880 | 1.41643 | 2218.0 | 391471 |
| 707 | 499849 | 353393243 | 26.5895 | 8.9085 | 2.84942 | 1.41443 | 2221.1 | 392580 |
| 708 | 501264 | 354894912 | 26.6083 | 8.9127 | 2.85003 | 1.41243 | 2224.2 | 393692 |
| 709 | 502681 | 356400829 | 26.6271 | 8.9169 | 2.85065 | 1.41044 | 2227.4 | 394805 |
| 710 | 504100 | 357911000 | 26.6458 | 8.9211 | 2.85126 | 1.40845 | 2230.5 | 395919 |
| 711 | 505521 | 359425431 | 26.6646 | 8.9253 | 2.85187 | 1.40647 | 2233.7 | 397035 |
| 712 | 506944 | 360944128 | 26.6833 | 8.9295 | 2.85248 | 1.40449 | 2236.8 | 398153 |
| 713 | 508369 | 362467097 | 26.7021 | 8.9337 | 2.85309 | 1.40252 | 2240.0 | 399272 |
| 714 | 509796 | 363994344 | 26.7208 | 8.9378 | 2.85370 | 1.40056 | 2243 1 | 400393 |
| 715 | 511225 | 365525875 | 26.7395 | 8.9420 | 2.85431 | 1.39860 | 2246.2 | 401515 |
| 716 | 512656 | 367061696 | 26.7582 | 8.9462 | 2.85491 | 1.39665 | 2249.4 | 402639 |
| 717 | 514089 | 368601813 | 26.7769 | 8.9503 | 2.85552 | 1.39470 | 2252.5 | 403765 |
| 718 | 515524 | 370146232 | 26.7955 | 8.9545 | 2.85612 | 1.39276 | 2255.7 | 404892 |
| 719 | 516961 | 371694959 | 26.8142 | 8.9587 | 2.85673 | 1.39082 | 2258.8 | 406020 |
| 720 | 518400 | 373248000 | 26.8328 | 8.9628 | 2.85733 | 1.38889 | 2261.9 | 407150 |
| 721 | 519841 | 374805361 | 26.8514 | 8.9670 | 2.85794 | 1.38696 | 2265.1 | 408282 |
| 722 | 521284 | 376367048 | 26.8701 | 8.9711 | 2.85854 | 1.38504 | 2268.2 | 409415 |
| 723 | 522729 | 377933067 | 26.8887 | 8.9752 | 2.85914 | 1.38313 | 2271.4 | 410550 |
| 724 | 524176 | 379503424 | 26.9072 | 8.9794 | 2.85974 | 1.38122 | 2274.5 | 411687 |
| 725 | 525625 | 381078125 | 26.9258 | 8.9835 | 2.86034 | 1.37931 | 2277.7 | 412825 |
| 726 | 527076 | 382657176 | 26.9444 | 8.9876 | 2.86094 | 1.37741 | 2280.8 | 413965 |
| 727 | 528529 | 384240583 | 26.9629 | 8.9918 | 2.86153 | 1.37552 | 2283.9 | 415106 |
| 728 | 529984 | 385828352 | 26.9815 | 8.9959 | 2.86213 | 1.37363 | 2287.1 | 416248 |
| 729 | 531441 | 387420489 | 27.0000 | 9.0000 | 2.86273 | 1.37174 | 2290.2 | 417393 |
| 730 | 532900 | 389017000 | 27.0185 | 9.0041 | 2.86332 | 1.36986 | 2293.4 | 418539 |
| 731 | 534361 | 390617891 | 27.0370 | 9.0082 | 2.86392 | 1.36799 | 2296.5 | 419686 |
| 732 | 535824 | 392223168 | 27.0555 | 9.0123 | 2.86451 | 1.36612 | 2299.6 | 420835 |
| 733 | 537289 | 393832837 | 27.0740 | 9.0164 | 2.86510 | 1.36426 | 2302.8 | 421986 |
| 734 | 538756 | 395446904 | 27.0924 | 9.0205 | 2.86570 | 1.36240 | 2305.9 | 423138 |
| 735 | 540225 | 397065375 | 27.1109 | 9.0246 | 2.86629 | 1.36054 | 2309.1 | 424293 |
| 736 | 541696 | 398688256 | 27.1293 | 9.0287 | 2.86688 | 1.35870 | 2312.2 | 425447 |
| 737 | 543169 | 400315553 | 27.1477 | 9.0328 | 2.86747 | 1.35685 | 2315.4 | 426604 |
| 738 | 544644 | 401947272 | 27.1662 | 9.0369 | 2.86806 | 1.35501 | 2318.5 | 427762 |
| 739 | 546121 | 403583419 | 27.1846 | 9.0410 | 2.86864 | 1.35318 | 2321.6 | 428922 |
| 740 | 547600 | 405224000 | 27.2029 | 9.0450 | 2.86923 | 1.35135 | 2324.8 | 430084 |
| 741 | 549081 | 406869021 | 27.2213 | 9.0491 | 2.86982 | 1.34953 | 2327.9 | 431247 |
| 742 | 550564 | 408518488 | 27.2397 | 9.0532 | 2.87040 | 1.34771 | 2331.1 | 432412 |
| 743 | 552049 | 410172407 | 27.2580 | 9.0572 | 2.87099 | 1.34590 | 2334.2 | 433578 |
| 744 | 553536 | 411830784 | 27.2764 | 9.0613 | 2.87157 | 1.34409 | 2337.3 | 434746 |
| 745 | 555025 | 413493625 | 27.2947 | 9.0654 | 2.87216 | 1.34228 | 2340.5 | 435916 |
| 746 | 556516 | 415160936 | 27.3130 | 9.0694 | 2.87274 | 1.34048 | 2343.6 | 437087 |
| 747 | 558009 | 416832723 | 27.3313 | 9.0735 | 2.87332 | 1.33869 | 2346.8 | 438259 |
| 748 | 559504 | 418508992 | 27.3496 | 9.0775 | 2.87390 | 1.33690 | 2349.9 | 439433 |
| 749 | 561001 | 420189749 | 27.3679 | 9.0816 | 2.87448 | 1.33511 | 2353.1 | 440609 |

# FUNCTIONS OF NUMBERS 750 TO 799

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 750 | 562500 | 421875000 | 27.3861 | 9.0856 | 2.87506 | 1.33333 | 2356.2 | 441786 |
| 751 | 564001 | 423564751 | 27.4044 | 9.0896 | 2.87564 | 1.33156 | 2359.3 | 442965 |
| 752 | 565504 | 425259008 | 27.4226 | 9.0937 | 2.87622 | 1.32979 | 2362.5 | 444146 |
| 753 | 567009 | 426957777 | 27.4408 | 9.0977 | 2.87680 | 1.32802 | 2365.6 | 445328 |
| 754 | 568516 | 428661064 | 27.4591 | 9.1017 | 2.87737 | 1.32626 | 2368.8 | 446511 |
| 755 | 570025 | 430368875 | 27.4773 | 9 1057 | 2.87795 | 1.32450 | 2371.9 | 447697 |
| 756 | 571536 | 432081216 | 27.4955 | 9.1098 | 2.87852 | 1.32275 | 2375.0 | 448883 |
| 757 | 573049 | 433798093 | 27.5136 | 9.1138 | 2.87910 | 1.32100 | 2378.2 | 450072 |
| 758 | 574564 | 435519512 | 27.5318 | 9.1178 | 2.87967 | 1.31926 | 2381.3 | 451262 |
| 759 | 576081 | 437245479 | 27.5500 | 9.1218 | 2.88024 | 1.31752 | 2384.5 | 452453 |
| 760 | 577600 | 438976000 | 27.5681 | 9.1258 | 2.88081 | 1.31579 | 2387.6 | 453646 |
| 761 | 579121 | 440711081 | 27.5862 | 9.1298 | 2.88138 | 1.31406 | 2390.8 | 454841 |
| 762 | 580644 | 442450728 | 27.6043 | 9.1338 | 2.88196 | 1.31234 | 2393.9 | 456037 |
| 763 | 582169 | 44194947 | 27.6225 | 9.1378 | 2.88252 | 1.31062 | 2397.0 | 457234 |
| 764 | 583696 | 445943744 | 27.6405 | 9.1418 | 2.88309 | 1.30890 | 2400.2 | 458434 |
| 765 | 585225 | 447697125 | 27.6586 | 9.1458 | 2.88366 | 1.30719 | 2403.3 | 459635 |
| 766 | 586756 | 449455096 | 27.6767 | 9.1498 | 2.88423 | 1.30548 | 2406.5 | 460837 |
| 767 | 588289 | 451217663 | 27.6948 | 9.1537 | 2.88480 | 1.30378 | 2409.6 | 462041 |
| 768 | 589824 | 452984832 | 27.7128 | 9.1577 | 2.88536 | 1.30208 | 2412.7 | 463247 |
| 769 | 591361 | 454756609 | 27.7308 | 9.1617 | 2.88593 | 1.30039 | 2415.9 | 464454 |
| 770 | 592900 | 456533000 | 27.7489 | 9.1657 | 2.88649 | 1.29870 | 2419.0 | 465663 |
| 771 | 594441 | 458314011 | 27.7669 | 9.1696 | 2.88705 | 1.29702 | 2422.2 | 466873 |
| 772 | 595984 | 460099648 | 27.7849 | 9.1736 | 2.88762 | 1.29534 | 2425.3 | 468085 |
| 773 | 597529 | 461889917 | 27.8029 | 9.1775 | 2.88818 | 1.29366 | 2428.5 | 469298 |
| 774 | 599076 | 463684824 | 27.8209 | 9.1815 | 2.88874 | 1.29199 | 2431.6 | 470513 |
| 775 | 600625 | 465484375 | 27.8388 | 9.1855 | 2.88930 | 1.29032 | 2434.7 | 471730 |
| 776 | 602176 | 467288576 | 27.8568 | 9.1894 | 2.88986 | 1.28866 | 2437.9 | 472948 |
| 777 | 603729 | 469097433 | 27.8747 | 9.1933 | 2.89042 | 1.28700 | 2441.0 | 474168 |
| 778 | 605284 | 470910952 | 27.8927 | 9.1973 | 2.89098 | 1.28535 | 2444.2 | 475389 |
| 779 | 606841 | 472729139 | 27.9106 | 9.2012 | 2.89154 | 1.28370 | 2447.3 | 476612 |
| 780 | 608400 | 474552000 | 27.9285 | 9.2052 | 2.89209 | 1.28205 | 2450.4 | 477836 |
| 781 | 609961 | 476379541 | 27.9464 | 9.2091 | 2.89265 | 1.28041 | 2453.6 | 479062 |
| 782 | 611524 | 478211768 | 27.9643 | 9.2130 | 2.89321 | 1.27877 | 2456.7 | 480290 |
| 783 | 613089 | 480048687 | 27.9821 | 9.2170 | 2.89376 | 1.27714 | 2459.9 | 481519 |
| 784 | 614656 | 481890304 | 28.0000 | 9.2209 | 2.89432 | 1.27551 | 2463.0 | 482750 |
| 785 | 616225 | 483736625 | 28.0179 | 9.2248 | 2.89487 | 1.27389 | 2466.2 | 483982 |
| 786 | 617796 | 485587656 | 28.0357 | 9.2287 | 2.89542 | 1.27226 | 2469.3 | 485216 |
| 787 | 619369 | 487443403 | 28.0535 | 9.2326 | 2.89597 | 1.27065 | 2472.4 | 486451 |
| 788 | 620944 | 489303872 | 28.0713 | 9.2365 | 2.89653 | 1.26904 | 2475.6 | 487688 |
| 789 | 622521 | 491169069 | 28.0891 | 9.2404 | 2.89708 | 1.26743 | 2478.7 | 488927 |
| 790 | 624100 | 493039000 | 28.1069 | 9.2443 | 2.89763 | 1.26582 | 2481.9 | 490167 |
| 791 | 625681 | 494913671 | 28.1247 | 9.2482 | 2.89818 | 1.26422 | 2485.0 | 491409 |
| 792 | 627264 | 496793088 | 28.1425 | 9.2521 | 2.89873 | 1.26263 | 2488.1 | 492652 |
| 793 | 628849 | 498677257 | 28.1603 | 9.2560 | 2.89927 | 1.26103 | 2491.3 | 493897 |
| 794 | 630436 | 500566184 | 28.1780 | 9.2599 | 2.89982 | 1.25945 | 2494.4 | 495143 |
| 795 | 632025 | 502459875 | 28.1957 | 9.2638 | 2.90037 | 1.25786 | 2497.6 | 496391 |
| 796 | 633616 | 504358336 | 28.2135 | 9.2677 | 2.90091 | 1.25628 | 2500.7 | 497641 |
| 797 | 635209 | 506261573 | 28.2312 | 9.2716 | 2.90146 | 1.25471 | 2503.8 | 498892 |
| 798 | 636804 | 508169592 | 28.2489 | 9.2754 | 2.90200 | 1.25313 | 2507.0 | 500145 |
| 799 | 638401 | 510082399 | 28.2666 | 9.2793 | 2.90255 | 1.25156 | 2510.1 | 501399 |

# 800 TO 849 FUNCTIONS OF NUMBERS

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 800 | 640000 | 512000000 | 28.2843 | 9.2832 | 2.90309 | 1.25000 | 2513.3 | 502655 |
| 801 | 641601 | 513922401 | 28.3019 | 9.2870 | 2.90363 | 1.24844 | 2516.4 | 503912 |
| 802 | 643204 | 515849608 | 28.3196 | 9.2909 | 2.90417 | 1.24688 | 2519.6 | 505171 |
| 803 | 644809 | 517781627 | 28.3373 | 9.2948 | 2.90472 | 1.24533 | 2522.7 | 506432 |
| 804 | 646416 | 519718464 | 28.3549 | 9.2986 | 2.90526 | 1.24378 | 2525.8 | 507694 |
| 805 | 648025 | 521660125 | 28.3725 | 9.3025 | 2.90580 | 1.24224 | 2529.0 | 508958 |
| 806 | 649636 | 523606616 | 28.3901 | 9.3063 | 2.90634 | 1.24069 | 2532.1 | 510223 |
| 807 | 651249 | 525557943 | 28.4077 | 9.3102 | 2.90687 | 1.23916 | 2535.3 | 511490 |
| 808 | 652864 | 527514112 | 28.4253 | 9.3140 | 2.90741 | 1.23762 | 2538.4 | 512758 |
| 809 | 654481 | 529475129 | 28.4429 | 9.3179 | 2.90795 | 1.23609 | 2541.5 | 514028 |
| 810 | 656100 | 531441000 | 28.4605 | 9.3217 | 2.90849 | 1.23457 | 2544.7 | 515300 |
| 811 | 657721 | 533411731 | 28.4781 | 9.3255 | 2.90902 | 1.23305 | 2547.8 | 516573 |
| 812 | 659344 | 535387328 | 28.4956 | 9.3294 | 2.90956 | 1.23153 | 2551.0 | 517848 |
| 813 | 660969 | 537367797 | 28.5132 | 9.3332 | 2.91009 | 1.23001 | 2554.1 | 519124 |
| 814 | 662596 | 539353144 | 28.5307 | 9.3370 | 2.91062 | 1.22850 | 2557.3 | 520402 |
| 815 | 664225 | 541343375 | 28.5482 | 9.3408 | 2.91116 | 1.22699 | 2560.4 | 521681 |
| 816 | 665856 | 543338496 | 28.5657 | 9.3447 | 2.91169 | 1.22549 | 2563.5 | 522962 |
| 817 | 667489 | 545338513 | 28.5832 | 9.3485 | 2.91222 | 1.22399 | 2566.7 | 524245 |
| 818 | 669124 | 547343432 | 28.6007 | 9.3523 | 2.91275 | 1.22249 | 2569.8 | 525529 |
| 819 | 670761 | 549353259 | 28.6182 | 9.3561 | 2.91328 | 1.22100 | 2573.0 | 526814 |
| 820 | 672400 | 551368000 | 28.6356 | 9.3599 | 2.91381 | 1.21951 | 2576.1 | 528102 |
| 821 | 674041 | 553387661 | 28.6531 | 9.3637 | 2.91434 | 1.21803 | 2579.2 | 529391 |
| 822 | 675684 | 555412248 | 28.6705 | 9.3675 | 2.91487 | 1.21655 | 2582.4 | 530681 |
| 823 | 677329 | 557441767 | 28.6880 | 9.3713 | 2.91540 | 1.21507 | 2585.5 | 531973 |
| 824 | 678976 | 559476224 | 28.7054 | 9.3751 | 2.91593 | 1.21359 | 2588.7 | 533267 |
| 825 | 680625 | 561515625 | 28.7228 | 9.3789 | 2.91645 | 1.21212 | 2591.8 | 534562 |
| 826 | 682276 | 563559976 | 28.7402 | 9.3827 | 2.91698 | 1.21065 | 2595.0 | 535858 |
| 827 | 683929 | 565609283 | 28.7576 | 9.3865 | 2.91751 | 1.20919 | 2598.1 | 537157 |
| 828 | 685584 | 567663552 | 28.7750 | 9.3902 | 2.91803 | 1.20773 | 2601.2 | 538456 |
| 829 | 687241 | 569722789 | 28.7924 | 9.3940 | 2.91855 | 1.20627 | 2604.4 | 539758 |
| 830 | 688900 | 571787000 | 28.8097 | 9.3978 | 2.91908 | 1.20482 | 2607.5 | 541061 |
| 831 | 690561 | 573856191 | 28.8271 | 9.4016 | 2.91960 | 1.20337 | 2610.7 | 542365 |
| 832 | 692224 | 575930368 | 28.8444 | 9.4053 | 2.92012 | 1.20192 | 2613.8 | 543671 |
| 833 | 693889 | 578009537 | 28.8617 | 9.4091 | 2.92065 | 1.20048 | 2616.9 | 544979 |
| 834 | 695556 | 580093704 | 28.8791 | 9.4129 | 2.92117 | 1.19904 | 2620.1 | 546288 |
| 835 | 697225 | 582182875 | 28.8964 | 9.4166 | 2.92169 | 1.19760 | 2623.2 | 547599 |
| 836 | 698896 | 584277056 | 28.9137 | 9.4204 | 2.92221 | 1.19617 | 2626.4 | 548912 |
| 837 | 700569 | 586376253 | 28.9310 | 9.4241 | 2.92273 | 1.19474 | 2629.5 | 550226 |
| 838 | 702244 | 588480472 | 28.9482 | 9.4279 | 2.92324 | 1.19332 | 2632.7 | 551541 |
| 839 | 703921 | 590589719 | 28.9655 | 9.4316 | 2.92376 | 1.19190 | 2635.8 | 552858 |
| 840 | 705600 | 592704000 | 28.9828 | 9.4354 | 2.92428 | 1.19048 | 2638.9 | 554177 |
| 841 | 707281 | 594823321 | 29.0000 | 9.4391 | 2.92480 | 1.18906 | 2642.1 | 555497 |
| 842 | 708964 | 596947688 | 29.0172 | 9.4429 | 2.92531 | 1.18765 | 2645.2 | 556819 |
| 843 | 710649 | 599077107 | 29.0345 | 9.4466 | 2.92583 | 1.18624 | 2648.4 | 558142 |
| 844 | 712336 | 601211584 | 29.0517 | 9.4503 | 2.92634 | 1.18483 | 2651.5 | 559467 |
| 845 | 714025 | 603351125 | 29.0689 | 9.4541 | 2.92686 | 1.18343 | 2654.6 | 560794 |
| 846 | 715716 | 605495736 | 29.0861 | 9.4578 | 2.92737 | 1.18203 | 2657.8 | 562122 |
| 847 | 717409 | 607645423 | 29.1033 | 9.4615 | 2.92788 | 1.18064 | 2660.9 | 563452 |
| 848 | 719104 | 609800192 | 29.1204 | 9.4652 | 2.92840 | 1.17925 | 2664.1 | 564783 |
| 849 | 720801 | 611960049 | 29.1376 | 9.4690 | 2.92891 | 1.17786 | 2667.2 | 566116 |

# FUNCTIONS OF NUMBERS 850 TO 899

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. – Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 850 | 722500 | 614125000 | 29.1548 | 9 4727 | 2 92942 | 1 17647 | 2670 4 | 567450 |
| 851 | 724201 | 616295051 | 29 1719 | 9 4764 | 2.92993 | 1.17509 | 2673.5 | 568786 |
| 852 | 725904 | 618470208 | 29 1890 | 9 4801 | 2.93044 | 1.17371 | 2676.6 | 570124 |
| 853 | 727609 | 620650477 | 29.2062 | 9 4838 | 2.93095 | 1.17233 | 2679 8 | 571463 |
| 854 | 729316 | 622835864 | 29 2233 | 9 4875 | 2 93146 | 1 17096 | 2682.9 | 572803 |
| 855 | 731025 | 625026375 | 29 2404 | 9 4912 | 2 93197 | 1 16959 | 2686 1 | 574146 |
| 856 | 732736 | 627222016 | 29.2575 | 9 4949 | 2 93247 | 1.16822 | 2689.2 | 575490 |
| 857 | 734449 | 629422793 | 29 2746 | 9.4986 | 2.93298 | 1.16686 | 2692.3 | 576835 |
| 858 | 736164 | 631628712 | 29.2916 | 9 5023 | 2.93349 | 1.16550 | 2695 5 | 578182 |
| 859 | 737881 | 633839779 | 29.3087 | 9 5060 | 2 93399 | 1.16414 | 2698.6 | 579530 |
| 860 | 739600 | 636056000 | 29.3258 | 9.5097 | 2 93450 | 1.16279 | 2701.8 | 580880 |
| 861 | 741321 | 638277381 | 29.3428 | 9.5134 | 2 93500 | 1.16144 | 2704 9 | 582232 |
| 862 | 743044 | 640503928 | 29.3598 | 9.5171 | 2.93551 | 1.16009 | 2708.1 | 583585 |
| 863 | 744769 | 642735647 | 29.3769 | 9.5207 | 2.93601 | 1.15875 | 2711.2 | 584940 |
| 864 | 746496 | 644972544 | 29.3939 | 9.5244 | 2.93651 | 1.15741 | 2714.3 | 586297 |
| 865 | 748225 | 647214625 | 29.4109 | 9.5281 | 2 93702 | 1.15607 | 2717.5 | 587655 |
| 866 | 749956 | 649461896 | 29.4279 | 9.5317 | 2 93752 | 1.15473 | 2720.6 | 589014 |
| 867 | 751689 | 651714363 | 29.4449 | 9.5354 | 2.93802 | 1.15340 | 2723.8 | 590375 |
| 868 | 753424 | 653972032 | 29.4618 | 9.5391 | 2.93852 | 1.15207 | 2726.9 | 591738 |
| 869 | 755161 | 656234909 | 29.4788 | 9.5427 | 2.93902 | 1.15075 | 2730.0 | 593102 |
| 870 | 756900 | 658503000 | 29.4958 | 9.5464 | 2.93952 | 1.14943 | 2733.2 | 594468 |
| 871 | 758641 | 660776311 | 29.5127 | 9.5501 | 2.94002 | 1.14811 | 2736.3 | 595835 |
| 872 | 760384 | 663054848 | 29.5296 | 9.5537 | 2 94052 | 1.14679 | 2739.5 | 597204 |
| 873 | 762129 | 665338617 | 29.5466 | 9.5574 | 2.94101 | 1.14548 | 2742.6 | 598575 |
| 874 | 763876 | 667627624 | 29.5635 | 9.5610 | 2.94151 | 1.14416 | 2745.8 | 599947 |
| 875 | 765625 | 669921875 | 29.5804 | 9 5647 | 2.94201 | 1.14286 | 2748.9 | 601320 |
| 876 | 767376 | 672221376 | 29.5973 | 9.5683 | 2.94250 | 1.14155 | 2752.0 | 602696 |
| 877 | 769129 | 674526133 | 29.6142 | 9.5719 | 2.94300 | 1.14025 | 2755.2 | 604073 |
| 878 | 770884 | 676836152 | 29.6311 | 9.5756 | 2 94349 | 1.13895 | 2758.3 | 605451 |
| 879 | 772641 | 679151439 | 29.6479 | 9.5792 | 2.94399 | 1.13766 | 2761.5 | 606831 |
| 880 | 774400 | 681472000 | 29.6648 | 9.5828 | 2.94448 | 1.13636 | 2764.6 | 608212 |
| 881 | 776161 | 683797841 | 29.6816 | 9.5865 | 2.94498 | 1.13507 | 2767.7 | 609595 |
| 882 | 777924 | 686128968 | 29.6985 | 9.5901 | 2.94547 | 1.13379 | 2770.9 | 610980 |
| 883 | 779689 | 688465387 | 29.7153 | 9.5937 | 2.94596 | 1.13250 | 2774.0 | 612366 |
| 884 | 781456 | 690807104 | 29.7321 | 9.5973 | 2.94645 | 1.13122 | 2777.2 | 613754 |
| 885 | 783225 | 693154125 | 29.7489 | 9.6010 | 2.94694 | 1.12994 | 2780.3 | 615143 |
| 886 | 784996 | 695506456 | 29.7658 | 9.6046 | 2 94743 | 1 12867 | 2783.5 | 616534 |
| 887 | 786769 | 697864103 | 29.7825 | 9.6082 | 2 94792 | 1.12740 | 2786.6 | 617927 |
| 888 | 788544 | 700227072 | 29.7993 | 9.6118 | 2.94841 | 1.12613 | 2789.7 | 619321 |
| 889 | 790321 | 702595369 | 29.8161 | 9.6154 | 2.94890 | 1.12486 | 2792.9 | 620717 |
| 890 | 792100 | 704969000 | 29.8329 | 9.6190 | 2.94939 | 1.12360 | 2796.0 | 622114 |
| 891 | 793881 | 707347971 | 29.8496 | 9.6226 | 2.94988 | 1.12233 | 2799.2 | 623513 |
| 892 | 795664 | 709732288 | 29.8664 | 9.6262 | 2.95036 | 1.12108 | 2802.3 | 624913 |
| 893 | 797449 | 712121957 | 29.8831 | 9.6298 | 2.95085 | 1.11982 | 2805.4 | 626315 |
| 894 | 799236 | 714516984 | 29.8998 | 9.6334 | 2.95134 | 1.11857 | 2808.6 | 627718 |
| 895 | 801025 | 716917375 | 29.9166 | 9.6370 | 2.95182 | 1.11732 | 2811.7 | 629124 |
| 896 | 802816 | 719323136 | 29 9333 | 9.6406 | 2.95231 | 1.11607 | 2814.9 | 630530 |
| 897 | 804609 | 721734273 | 29.9500 | 9 6442 | 2.95279 | 1.11483 | 2818.0 | 631938 |
| 898 | 806404 | 724150792 | 29.9666 | 9.6477 | 2.95328 | 1.11359 | 2821.2 | 633348 |
| 899 | 808201 | 726572699 | 29 9833 | 9 6513 | 2.95376 | 1.11235 | 2824.3 | 634760 |

## 900 TO 949 FUNCTIONS OF NUMBERS

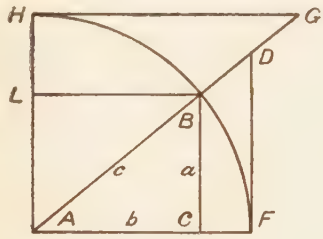
| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 900 | 810000 | 729000000 | 30.0000 | 9.6549 | 2.95424 | 1.11111 | 2827.4 | 636173 |
| 901 | 811801 | 731432701 | 30.0167 | 9.6585 | 2.95472 | 1.10988 | 2830.6 | 637587 |
| 902 | 813604 | 733870808 | 30.0333 | 9.6620 | 2.95521 | 1.10865 | 2833.7 | 639003 |
| 903 | 815409 | 736314327 | 30.0500 | 9.6656 | 2.95569 | 1.10742 | 2836.9 | 640421 |
| 904 | 817216 | 738763264 | 30.0666 | 9.6692 | 2.95617 | 1.10619 | 2840.0 | 641840 |
| 905 | 819025 | 741217625 | 30.0832 | 9.6727 | 2.95665 | 1.10497 | 2843.1 | 643261 |
| 906 | 820836 | 743677416 | 30.0998 | 9.6763 | 2.95713 | 1.10375 | 2846.3 | 644683 |
| 907 | 822649 | 746142643 | 30.1164 | 9.6799 | 2.95761 | 1.10254 | 2849.4 | 646107 |
| 908 | 824464 | 748613312 | 30.1330 | 9.6834 | 2.95809 | 1.10132 | 2852.6 | 647533 |
| 909 | 826281 | 751089429 | 30.1496 | 9.6870 | 2.95856 | 1.10011 | 2855.7 | 648960 |
| 910 | 828100 | 753571000 | 30.1662 | 9.6905 | 2.95904 | 1.09890 | 2858.8 | 650388 |
| 911 | 829921 | 756058031 | 30.1828 | 9.6941 | 2.95952 | 1.09769 | 2862.0 | 651818 |
| 912 | 831744 | 758550528 | 30.1993 | 9.6976 | 2.95999 | 1.09649 | 2865.1 | 653250 |
| 913 | 833569 | 761048497 | 30.2159 | 9.7012 | 2.96047 | 1.09529 | 2868.3 | 654684 |
| 914 | 835396 | 763551944 | 30.2324 | 9.7047 | 2.96095 | 1.09409 | 2871.4 | 656118 |
| 915 | 837225 | 766060875 | 30.2490 | 9.7082 | 2.96142 | 1.09290 | 2874.6 | 657555 |
| 916 | 839056 | 768575296 | 30.2655 | 9.7118 | 2.96190 | 1.09170 | 2877.7 | 658993 |
| 917 | 840889 | 771095213 | 30.2820 | 9.7153 | 2.96237 | 1.09051 | 2880.8 | 660433 |
| 918 | 842724 | 773620632 | 30.2985 | 9.7188 | 2.96284 | 1.08932 | 2884.0 | 661874 |
| 919 | 844561 | 776151559 | 30.3150 | 9.7224 | 2.96332 | 1.08814 | 2887.1 | 663317 |
| 920 | 846400 | 778688000 | 30.3315 | 9.7259 | 2.96379 | 1.08696 | 2890.3 | 664761 |
| 921 | 848241 | 781229961 | 30.3480 | 9.7294 | 2.96426 | 1.08578 | 2893.4 | 666207 |
| 922 | 850084 | 783777448 | 30.3645 | 9.7329 | 2.96473 | 1.08460 | 2896.5 | 667654 |
| 923 | 851929 | 786330467 | 30.3809 | 9.7364 | 2.96520 | 1.08342 | 2899.7 | 669103 |
| 924 | 853776 | 788889024 | 30.3974 | 9.7400 | 2.96567 | 1.08225 | 2902.8 | 670554 |
| 925 | 855625 | 791453125 | 30.4138 | 9.7435 | 2.96614 | 1.08108 | 2906.0 | 672006 |
| 926 | 857476 | 794022776 | 30.4302 | 9.7470 | 2.96661 | 1.07991 | 2909.1 | 673460 |
| 927 | 859329 | 796597983 | 30.4467 | 9.7505 | 2.96708 | 1.07875 | 2912.3 | 674915 |
| 928 | 861184 | 799178752 | 30.4631 | 9.7540 | 2.96755 | 1.07759 | 2915.4 | 676372 |
| 929 | 863041 | 801765089 | 30.4795 | 9.7575 | 2.96802 | 1.07643 | 2918.5 | 677831 |
| 930 | 864900 | 804357000 | 30.4959 | 9.7610 | 2.96848 | 1.07527 | 2921.7 | 679291 |
| 931 | 866761 | 806954491 | 30.5123 | 9.7645 | 2.96895 | 1.07411 | 2924.8 | 680752 |
| 932 | 868624 | 809557568 | 30.5287 | 9.7680 | 2.96942 | 1.07296 | 2928.0 | 682216 |
| 933 | 870489 | 812166237 | 30.5450 | 9.7715 | 2.96988 | 1.07181 | 2931.1 | 683680 |
| 934 | 872356 | 814780504 | 30.5614 | 9.7750 | 2.97035 | 1.07066 | 2934.2 | 685147 |
| 935 | 874225 | 817400375 | 30.5778 | 9.7785 | 2.97081 | 1.06952 | 2937.4 | 686615 |
| 936 | 876096 | 820025856 | 30.5941 | 9.7819 | 2.97128 | 1.06838 | 2940.5 | 688084 |
| 937 | 877969 | 822656953 | 30.6105 | 9.7854 | 2.97174 | 1.06724 | 2943.7 | 689555 |
| 938 | 879844 | 825293672 | 30.6268 | 9.7889 | 2.97220 | 1.06610 | 2946.8 | 691028 |
| 939 | 881721 | 827936019 | 30.6431 | 9.7924 | 2.97267 | 1.06496 | 2950.0 | 692502 |
| 940 | 883600 | 830584000 | 30.6594 | 9.7959 | 2.97313 | 1.06383 | 2953.1 | 693978 |
| 941 | 885481 | 833237621 | 30.6757 | 9.7993 | 2.97359 | 1.06270 | 2956.2 | 695455 |
| 942 | 887364 | 835896888 | 30.6920 | 9.8028 | 2.97405 | 1.06157 | 2959.4 | 696934 |
| 943 | 889249 | 838561807 | 30.7083 | 9.8063 | 2.97451 | 1.06045 | 2962.5 | 698415 |
| 944 | 891136 | 841232384 | 30.7246 | 9.8097 | 2.97497 | 1.05932 | 2965.7 | 699897 |
| 945 | 893025 | 843908625 | 30.7409 | 9.8132 | 2.97543 | 1.05820 | 2968.8 | 701380 |
| 946 | 894916 | 846590536 | 30.7571 | 9.8167 | 2.97589 | 1.05708 | 2971.9 | 702865 |
| 947 | 896809 | 849278123 | 30.7734 | 9.8201 | 2.97635 | 1.05597 | 2975.1 | 704352 |
| 948 | 898704 | 851971392 | 30.7896 | 9.8236 | 2.97681 | 1.05485 | 2978.2 | 705840 |
| 949 | 900601 | 854670349 | 30.8058 | 9.8270 | 2.97727 | 1.05374 | 2981.4 | 707330 |

# FUNCTIONS OF NUMBERS 950 TO 999

| No. | Square | Cube | Square Root | Cubic Root | Logarithm | 1000 × Reciprocal | No. = Diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Circum. | Area |
| 950 | 902500 | 857375000 | 30.8221 | 9.8305 | 2.97772 | 1.05263 | 2984.5 | 708822 |
| 951 | 904401 | 860085351 | 30.8383 | 9.8339 | 2.97818 | 1.05152 | 2987.7 | 710315 |
| 952 | 906304 | 862801408 | 30.8545 | 9.8374 | 2.97864 | 1 05042 | 2990.8 | 711809 |
| 953 | 908209 | 865523177 | 30.8707 | 9.8408 | 2.97909 | 1.04932 | 2993.9 | 713306 |
| 954 | 910116 | 868250664 | 30.8869 | 9.8443 | 2.97955 | 1.04822 | 2997.1 | 714803 |
| 955 | 912025 | 870983875 | 30.9031 | 9.8477 | 2.98000 | 1.04712 | 3000.2 | 716303 |
| 956 | 913936 | 873722816 | 30.9192 | 9.8511 | 2.98046 | 1.04603 | 3003.4 | 717804 |
| 957 | 915849 | 876467493 | 30.9354 | 9.8546 | 2.98091 | 1.04493 | 3006.5 | 719306 |
| 958 | 917764 | 879217912 | 30.9516 | 9.8580 | 2.98137 | 1.04384 | 3009.6 | 720810 |
| 959 | 919681 | 881974079 | 30.9677 | 9.8614 | 2.98182 | 1.04275 | 3012.8 | 722316 |
| 960 | 921600 | 884736000 | 30.9839 | 9.8648 | 2.98227 | 1.04167 | 3015.9 | 723823 |
| 961 | 923521 | 887503681 | 31.0000 | 9.8683 | 2.98272 | 1.04058 | 3019.1 | 725332 |
| 962 | 925444 | 890277128 | 31.0161 | 9.8717 | 2.98318 | 1.03950 | 3022.2 | 726842 |
| 963 | 927369 | 893056347 | 31.0322 | 9.8751 | 2.98363 | 1.03842 | 3025.4 | 728354 |
| 964 | 929296 | 895841344 | 31.0483 | 9.8785 | 2.98408 | 1.03734 | 3028.5 | 729867 |
| 965 | 931225 | 898632125 | 31.0644 | 9.8819 | 2.98453 | 1.03627 | 3031.6 | 731382 |
| 966 | 933156 | 901428696 | 31.0805 | 9.8854 | 2.98498 | 1.03520 | 3034.8 | 732899 |
| 967 | 935089 | 904231063 | 31.0966 | 9.8888 | 2.98543 | 1.03413 | 3037.9 | 734417 |
| 968 | 937024 | 907039232 | 31.1127 | 9.8922 | 2.98588 | 1.03306 | 3041.1 | 735937 |
| 969 | 938961 | 909853209 | 31.1288 | 9.8956 | 2.98632 | 1.03199 | 3044.2 | 737458 |
| 970 | 940900 | 912673000 | 31.1448 | 9.8990 | 2.98677 | 1.03093 | 3047.3 | 738981 |
| 971 | 942841 | 915498611 | 31.1609 | 9.9024 | 2.98722 | 1.02987 | 3050.5 | 740506 |
| 972 | 944784 | 918330048 | 31.1769 | 9.9058 | 2.98767 | 1.02881 | 3053.6 | 742032 |
| 973 | 946729 | 921167317 | 31.1929 | 9.9092 | 2.98811 | 1.02775 | 3056.8 | 743559 |
| 974 | 948676 | 924010424 | 31.2090 | 9.9126 | 2.98856 | 1.02669 | 3059.9 | 745088 |
| 975 | 950625 | 926859375 | 31.2250 | 9.9160 | 2.98900 | 1.02564 | 3063.1 | 746619 |
| 976 | 952576 | 929714176 | 31.2410 | 9.9194 | 2.98945 | 1.02459 | 3066.2 | 748151 |
| 977 | 954529 | 932574833 | 31.2570 | 9.9227 | 2.98989 | 1.02354 | 3069.3 | 749685 |
| 978 | 956484 | 935441352 | 31.2730 | 9.9261 | 2.99034 | 1.02249 | 3072.5 | 751221 |
| 979 | 958441 | 938313739 | 31.2890 | 9.9295 | 2.99078 | 1.02145 | 3075.6 | 752758 |
| 980 | 960400 | 941192000 | 31.3050 | 9.9329 | 2.99123 | 1.02041 | 3078.8 | 754296 |
| 981 | 962361 | 944076141 | 31.3209 | 9.9363 | 2.99167 | 1.01937 | 3081.9 | 755837 |
| 982 | 964324 | 946966168 | 31.3369 | 9.9396 | 2.99211 | 1.01833 | 3085.0 | 757378 |
| 983 | 966289 | 949862087 | 31.3528 | 9.9430 | 2.99255 | 1.01729 | 3088.2 | 758922 |
| 984 | 968256 | 952763904 | 31.3688 | 9.9464 | 2.99300 | 1.01626 | 3091.3 | 760466 |
| 985 | 970225 | 955671625 | 31.3847 | 9.9497 | 2.99344 | 1.01523 | 3094.5 | 762013 |
| 986 | 972196 | 958585256 | 31.4006 | 9.9531 | 2.99388 | 1.01420 | 3097.6 | 763561 |
| 987 | 974169 | 961504803 | 31.4166 | 9.9565 | 2.99432 | 1.01317 | 3100.8 | 765111 |
| 988 | 976144 | 964430272 | 31.4325 | 9.9598 | 2.99476 | 1.01215 | 3103.9 | 766662 |
| 989 | 978121 | 967361669 | 31.4484 | 9.9632 | 2.99520 | 1.01112 | 3107.0 | 768214 |
| 990 | 980100 | 970299000 | 31.4643 | 9.9666 | 2.99564 | 1.01010 | 3110.2 | 769769 |
| 991 | 982081 | 973242271 | 31.4802 | 9.9699 | 2.99607 | 1.00908 | 3113.3 | 771325 |
| 992 | 984064 | 976191488 | 31.4960 | 9.9733 | 2.99651 | 1.00806 | 3116.5 | 772882 |
| 993 | 986049 | 979146657 | 31.5119 | 9.9766 | 2.99695 | 1.00705 | 3119.6 | 774441 |
| 994 | 988036 | 982107784 | 31.5278 | 9.9800 | 2.99739 | 1.00604 | 3122.7 | 776002 |
| 995 | 990025 | 985074875 | 31.5436 | 9.9833 | 2.99782 | 1.00503 | 3125.9 | 777564 |
| 996 | 992016 | 988047936 | 31.5595 | 9.9866 | 2.99826 | 1.00402 | 3129.0 | 779128 |
| 997 | 994009 | 991026973 | 31.5753 | 9 9900 | 2.99870 | 1.00301 | 3132.2 | 780693 |
| 998 | 996004 | 994011992 | 31.5911 | 9.9933 | 2.99913 | 1.00200 | 3135.3 | 782260 |
| 999 | 998001 | 997002999 | 31.6070 | 9.9967 | 2.99957 | 1.00100 | 3138.5 | 783828 |

# TRIGONOMETRIC FORMULAE

## TRIGONOMETRIC FUNCTIONS




Radius $AF = 1$

$= \sin^2 A + \cos^2 A = \sin A \operatorname{cosec} A$

$= \cos A \sec A = \tan A \cot A$

Sine $A = \dfrac{\cos A}{\cot A} = \dfrac{1}{\operatorname{cosec} A} = \cos A \tan A = \sqrt{1-\cos^2 A} = BC$

Cosine $A = \dfrac{\sin A}{\tan A} = \dfrac{1}{\sec A} = \sin A \cot A = \sqrt{1-\sin^2 A} = AC$

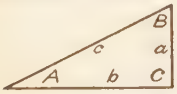
Tangent $A = \dfrac{\sin A}{\cos A} = \dfrac{1}{\cot A} = \sin A \sec A = FD$

Cotangent $A = \dfrac{\cos A}{\sin A} = \dfrac{1}{\tan A} = \cos A \operatorname{cosec} A = HG$

Secant $A = \dfrac{\tan A}{\sin A} = \dfrac{1}{\cos A} = AD$

Cosecant $A = \dfrac{\cot A}{\cos A} = \dfrac{1}{\sin A} = AG$

## TRIGONOMETRIC SOLUTION OF TRIANGLES

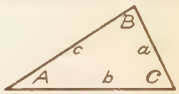



$a^2 = b^2 + c^2 - 2bc \cos A$

$b^2 = a^2 + c^2 - 2ac \cos B$

$c^2 = a^2 + b^2 - 2ab \cos C$

$s = \dfrac{a+b+c}{2}$



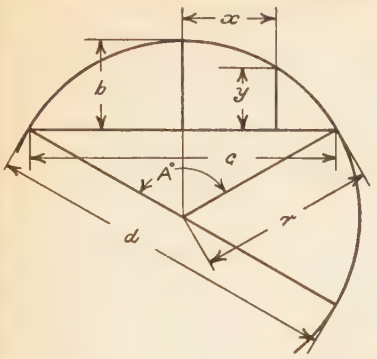

### RIGHT ANGLED TRIANGLES

| Known, | Required | | | | | | |
|---|---|---|---|---|---|---|---|
| | $A$ | $B$ | $C$ | $a$ | $b$ | $c$ | Area |
| $a, b$ | $\tan A = \dfrac{a}{b}$ | $\tan B = \dfrac{b}{a}$ | $90°$ | | | $\sqrt{a^2+b^2}$ | $\dfrac{ab}{2}$ |
| $a, c$ | $\sin A = \dfrac{a}{c}$ | $\cos B = \dfrac{a}{c}$ | $90°$ | | $\sqrt{c^2-a^2}$ | | $\dfrac{a\sqrt{c^2-a^2}}{2}$ |
| $A, a$ | | $90° - A$ | $90°$ | | $a \cot A$ | $\dfrac{a}{\sin A}$ | $\dfrac{a^2 \cot A}{2}$ |
| $A, b$ | | $90° - A$ | $90°$ | $b \tan A$ | | $\dfrac{b}{\cos A}$ | $\dfrac{b^2 \tan A}{2}$ |
| $A, c$ | | $90° - A$ | $90°$ | $c \sin A$ | $c \cos A$ | | $\dfrac{c^2 \sin 2A}{4}$ |

### OBLIQUE ANGLED TRIANGLES

| Known | Required | | | | | |
|---|---|---|---|---|---|---|
| | $A$ | $B$ | $C$ | $b$ | $c$ | Area |
| $a, b, c$ | $\cos \frac{1}{2}A = \sqrt{\dfrac{s(s-a)}{bc}}$ | $\cos \frac{1}{2}B = \sqrt{\dfrac{s(s-b)}{ac}}$ | $\cos \frac{1}{2}C = \sqrt{\dfrac{s(s-c)}{ab}}$ | | | $\sqrt{s(s-a)(s-b)(s-c)}$ |
| $a, A, B$ | | | $180° - (A+B)$ | $\dfrac{a \sin B}{\sin A}$ | $\dfrac{a \sin C}{\sin A}$ | |
| $a, b, A$ | | $\sin B = \dfrac{b \sin A}{a}$ | | | $\dfrac{b \sin C}{\sin B}$ | |
| $a, b, C$ | $\tan A = \dfrac{a \sin C}{b - a \cos C}$ | | | | $\sqrt{a^2+b^2-2ab\cos C}$ | $\dfrac{ab \sin C}{2}$ |

# PROPERTIES OF THE CIRCLE




$\pi = 3.14159265359$

Circumference $= 2\pi r = \pi d$

Diameter = Circumference $\times$ 0.31831

Area $= \pi r^2$

Diameter of Circle of equal periphery as square
= side of square $\times$ 1.27324

Side of Square of equal periphery as circle
= diameter of circle $\times$ 0.78540

Diameter of Circle circumscribed about square
= side of square $\times$ 1.41421

Side of Square inscribed in a circle
= diameter of circle $\times$ 0.70711

Arc $a = \dfrac{\pi r A^\circ}{180} = 0.017453\, r A^\circ$

Angle $A = \dfrac{180^\circ a}{\pi r} = 57.29578 \dfrac{a}{r}$

Radius $r = \dfrac{4b^2 + c^2}{8b}$

Chord $c = 2\sqrt{2br - b^2} = 2r \sin \dfrac{A^\circ}{2}$

Rise $b = r - \frac{1}{2}\sqrt{4r^2 - c^2} = \dfrac{c}{2} \tan \dfrac{A^\circ}{4}$

$= 2r \sin^2 \dfrac{A}{4} = r + y - \sqrt{r^2 - x^2}$

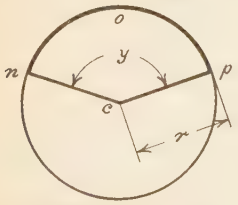
$y = b - r + \sqrt{r^2 - x^2}$

$x = \sqrt{r^2 - (r + y - b)^2}$

$\pi^2 = 9.8696044$, log = 0.9942997 $\quad \dfrac{1}{\pi} = 0.3183099$, log = $\bar{1}.5028501$ $\quad \sqrt{\dfrac{1}{\pi}} = 0.5641896$, log = $\bar{1}.7514251$

$\pi^3 = 31.0062767$, log = 1.4914496 $\quad \dfrac{1}{\pi^2} = 0.1013212$, log = $\bar{1}.0057003$ $\quad \dfrac{\pi}{180} = 0.0174533$, log = $\bar{2}.2418774$

$\sqrt{\pi} = 1.7724539$, log = 0.2485749 $\quad \dfrac{1}{\pi^3} = 0.0322515$, log = $\bar{2}.5085500$ $\quad \dfrac{180}{\pi} = 57.2957795$, log = 1.7581226



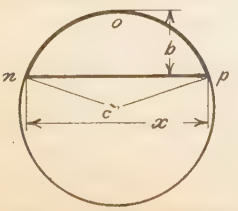

## CIRCULAR SECTOR

$r$ = radius of circle $\quad y$ = angle $n\,c\,p\,o$ in degrees

Area of Sector $n\,c\,p\,o = \frac{1}{2}$ (length of arc $n\,o\,p \times r$)

$= \text{Area of Circle} \times \dfrac{y}{360}$

$= 0.0087266 \times r^2 \times y$




## CIRCULAR SEGMENT

$r$ = radius of circle $\quad s$ = chord $\quad b$ = rise

Area of Segment $n\,o\,p$ = Area of Sector $n\,c\,p\,o$ − Area of triangle $n\,c\,p$

$= \dfrac{(\text{Length of arc } n\,o\,p \times r) - s\,(r - b)}{2}$

Area of Segment $n\,s\,p$ = Area of Circle − Area of Segment $n\,o\,p$

# NATURAL SINES AND COSINES

| Degrees | Sines | | | | | | | Cosines |
|---|---|---|---|---|---|---|---|---|
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 0 | 0.00000 | 0.00291 | 0.00582 | 0.00873 | 0.01164 | 0.01454 | 0.01745 | 89 |
| 1 | 0.01745 | 0.02036 | 0.02327 | 0.02618 | 0.02908 | 0.03199 | 0.03490 | 88 |
| 2 | 0.03490 | 0.03781 | 0.04071 | 0.04362 | 0.04653 | 0.04943 | 0.05234 | 87 |
| 3 | 0.05234 | 0.05524 | 0.05814 | 0.06105 | 0.06395 | 0.06685 | 0.06976 | 86 |
| 4 | 0.06976 | 0.07266 | 0.07556 | 0.07846 | 0.08136 | 0 08426 | 0.08716 | 85 |
| 5 | 0.08716 | 0.09005 | 0.09295 | 0.09585 | 0.09874 | 0.10164 | 0.10453 | 84 |
| 6 | 0.10453 | 0.10742 | 0.11031 | 0.11320 | 0.11609 | 0.11898 | 0.12187 | 83 |
| 7 | 0.12187 | 0.12476 | 0.12764 | 0.13053 | 0.13341 | 0.13629 | 0.13917 | 82 |
| 8 | 0.13917 | 0.14205 | 0.14493 | 0.14781 | 0.15069 | 0.15356 | 0.15643 | 81 |
| 9 | 0.15643 | 0.15931 | 0.16218 | 0.16505 | 0.16792 | 0.17078 | 0.17365 | 80 |
| 10 | 0.17365 | 0.17651 | 0.17937 | 0.18224 | 0 18509 | 0.18795 | 0.19081 | 79 |
| 11 | 0.19081 | 0.19366 | 0.19652 | 0.19937 | 0.20222 | 0.20507 | 0.20791 | 78 |
| 12 | 0.20791 | 0.21076 | 0.21360 | 0.21644 | 0.21928 | 0.22212 | 0.22495 | 77 |
| 13 | 0.22495 | 0.22778 | 0.23062 | 0.23345 | 0.23627 | 0.23910 | 0.24192 | 76 |
| 14 | 0.24192 | 0.24474 | 0.24756 | 0.25038 | 0.25320 | 0.25601 | 0.25882 | 75 |
| 15 | 0.25882 | 0.26163 | 0.26443 | 0.26724 | 0.27004 | 0.27284 | 0.27564 | 74 |
| 16 | 0.27564 | 0.27843 | 0.28123 | 0.28402 | 0.28680 | 0.28959 | 0.29237 | 73 |
| 17 | 0.29237 | 0.29515 | 0.29793 | 0.30071 | 0.30348 | 0.30625 | 0.30902 | 72 |
| 18 | 0.30902 | 0.31178 | 0.31454 | 0.31730 | 0.32006 | 0.32282 | 0.32557 | 71 |
| 19 | 0.32557 | 0.32832 | 0.33106 | 0.33381 | 0.33655 | 0.33929 | 0.34202 | 70 |
| 20 | 0.34202 | 0.34475 | 0.34748 | 0.35021 | 0.35293 | 0.35565 | 0.35837 | 69 |
| 21 | 0.35837 | 0.36108 | 0.36379 | 0.36650 | 0.36921 | 0.37191 | 0.37461 | 68 |
| 22 | 0.37461 | 0.37730 | 0.37999 | 0.38268 | 0.38537 | 0.38805 | 0.39073 | 67 |
| 23 | 0.39073 | 0.39341 | 0.39608 | 0.39875 | 0.40142 | 0.40408 | 0.40674 | 66 |
| 24 | 0.40674 | 0.40939 | 0.41204 | 0.41469 | 0.41734 | 0.41998 | 0.42262 | 65 |
| 25 | 0.42262 | 0.42525 | 0.42788 | 0.43051 | 0.43313 | 0.43575 | 0.43837 | 64 |
| 26 | 0.43837 | 0.44098 | 0.44359 | 0.44620 | 0.44880 | 0.45140 | 0.45399 | 63 |
| 27 | 0.45399 | 0.45658 | 0.45917 | 0.46175 | 0.46433 | 0.46690 | 0.46947 | 62 |
| 28 | 0.46947 | 0.47204 | 0.47460 | 0.47716 | 0.47971 | 0.48226 | 0.48481 | 61 |
| 29 | 0.48481 | 0.48735 | 0.48989 | 0.49242 | 0.49495 | 0.49748 | 0.50000 | 60 |
| 30 | 0.50000 | 0.50252 | 0.50503 | 0.50754 | 0.51004 | 0.51254 | 0.51504 | 59 |
| 31 | 0.51504 | 0.51753 | 0.52002 | 0.52250 | 0.52498 | 0.52745 | 0.52992 | 58 |
| 32 | 0.52992 | 0.53238 | 0.53484 | 0.53730 | 0.53975 | 0.54220 | 0.54464 | 57 |
| 33 | 0.54464 | 0.54708 | 0.54951 | 0.55194 | 0.55436 | 0.55678 | 0.55919 | 56 |
| 34 | 0.55919 | 0.56160 | 0.56401 | 0.56641 | 0.56880 | 0.57119 | 0.57358 | 55 |
| 35 | 0.57358 | 0.57596 | 0.57833 | 0.58070 | 0.58307 | 0.58543 | 0.58779 | 54 |
| 36 | 0.58779 | 0.59014 | 0.59248 | 0.59482 | 0.59716 | 0.59949 | 0.60182 | 53 |
| 37 | 0.60182 | 0.60414 | 0.60645 | 0.60876 | 0.61107 | 0.61337 | 0.61566 | 52 |
| 38 | 0.61566 | 0.61795 | 0.62024 | 0.62251 | 0.62479 | 0.62706 | 0.62932 | 51 |
| 39 | 0.62932 | 0.63158 | 0.63383 | 0.63608 | 0.63832 | 0.64056 | 0.64279 | 50 |
| 40 | 0.64279 | 0.64501 | 0.64723 | 0.64945 | 0.65166 | 0.65386 | 0.65606 | 49 |
| 41 | 0.65606 | 0.65825 | 0.66044 | 0.66262 | 0.66480 | 0.66697 | 0.66913 | 48 |
| 42 | 0.66913 | 0.67129 | 0.67344 | 0.67559 | 0.67773 | 0.67987 | 0.68200 | 47 |
| 43 | 0.68200 | 0.68412 | 0.68624 | 0.68835 | 0.69046 | 0.69256 | 0.69466 | 46 |
| 44 | 0.69466 | 0.69675 | 0.69883 | 0.70091 | 0.70298 | 0.70505 | 0.70711 | 45 |
| Sines | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | Degrees |
| | Cosines | | | | | | | |

# NATURAL SINES AND COSINES

| Degrees | Cosines 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | Sines |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.00000 | 1.00000 | 0.99998 | 0.99996 | 0.99993 | 0.99989 | 0.99985 | 89 |
| 1 | 0.99985 | 0.99979 | 0.99973 | 0.99966 | 0.99958 | 0.99949 | 0.99939 | 88 |
| 2 | 0.99939 | 0.99929 | 0.99917 | 0.99905 | 0.99892 | 0.99878 | 0.99863 | 87 |
| 3 | 0.99863 | 0.99847 | 0.99831 | 0.99813 | 0.99795 | 0.99776 | 0.99756 | 86 |
| 4 | 0.99756 | 0.99736 | 0.99714 | 0.99692 | 0.99668 | 0.99644 | 0.99619 | 85 |
| 5 | 0.99619 | 0.99594 | 0.99567 | 0.99540 | 0.99511 | 0.99482 | 0.99452 | 84 |
| 6 | 0.99452 | 0.99421 | 0.99390 | 0.99357 | 0.99324 | 0.99290 | 0.99255 | 83 |
| 7 | 0.99255 | 0.99219 | 0.99182 | 0.99144 | 0.99106 | 0.99067 | 0.99027 | 82 |
| 8 | 0.99027 | 0.98986 | 0.98944 | 0.98902 | 0.98858 | 0.98814 | 0.98769 | 81 |
| 9 | 0.98769 | 0.98723 | 0.98676 | 0.98629 | 0.98580 | 0.98531 | 0.98481 | 80 |
| 10 | 0.98481 | 0.98430 | 0.98378 | 0.98325 | 0.98272 | 0.98218 | 0.98163 | 79 |
| 11 | 0.98163 | 0.98107 | 0.98050 | 0.97992 | 0.97934 | 0.97875 | 0.97815 | 78 |
| 12 | 0.97815 | 0.97754 | 0.97692 | 0.97630 | 0.97566 | 0.97502 | 0.97437 | 77 |
| 13 | 0.97437 | 0.97371 | 0.97304 | 0.97237 | 0.97169 | 0.97100 | 0.97030 | 76 |
| 14 | 0.97030 | 0.96959 | 0.96887 | 0.96815 | 0.96742 | 0.96667 | 0.96593 | 75 |
| 15 | 0.96593 | 0.96517 | 0.96440 | 0.96363 | 0.96285 | 0.96206 | 0.96126 | 74 |
| 16 | 0.96126 | 0.96046 | 0.95964 | 0.95882 | 0.95799 | 0.95715 | 0.95630 | 73 |
| 17 | 0.95630 | 0.95545 | 0.95459 | 0.95372 | 0.95284 | 0.95195 | 0.95106 | 72 |
| 18 | 0.95106 | 0.95015 | 0.94924 | 0.94832 | 0.94740 | 0.94646 | 0.94552 | 71 |
| 19 | 0.94552 | 0.94457 | 0.94361 | 0.94264 | 0.94167 | 0.94068 | 0.93969 | 70 |
| 20 | 0.93969 | 0.93869 | 0.93769 | 0.93667 | 0.93565 | 0.93462 | 0.93358 | 69 |
| 21 | 0.93358 | 0.93253 | 0.93148 | 0.93042 | 0.92935 | 0.92827 | 0.92718 | 68 |
| 22 | 0.92718 | 0.92609 | 0.92499 | 0.92388 | 0.92276 | 0.92164 | 0.92050 | 67 |
| 23 | 0.92050 | 0.91936 | 0.91822 | 0.91706 | 0.91590 | 0.91472 | 0.91355 | 66 |
| 24 | 0.91355 | 0.91236 | 0.91116 | 0.90996 | 0.90875 | 0.90753 | 0.90631 | 65 |
| 25 | 0.90631 | 0.90507 | 0.90383 | 0.90259 | 0.90133 | 0.90007 | 0.89879 | 64 |
| 26 | 0.89879 | 0.89752 | 0.89623 | 0.89493 | 0.89363 | 0.89232 | 0.89101 | 63 |
| 27 | 0.89101 | 0.88968 | 0.88835 | 0.88701 | 0.88566 | 0.88431 | 0.88295 | 62 |
| 28 | 0.88295 | 0.88158 | 0.88020 | 0.87882 | 0.87743 | 0.87603 | 0.87462 | 61 |
| 29 | 0.87462 | 0.87321 | 0.87178 | 0.87036 | 0.86892 | 0.86748 | 0.86603 | 60 |
| 30 | 0.86603 | 0.86457 | 0.86310 | 0.86163 | 0.86015 | 0.85866 | 0.85717 | 59 |
| 31 | 0.85717 | 0.85567 | 0.85416 | 0.85264 | 0.85112 | 0.84959 | 0.84805 | 58 |
| 32 | 0.84805 | 0.84650 | 0.84495 | 0.84339 | 0.84182 | 0.84025 | 0.83867 | 57 |
| 33 | 0.83867 | 0.83708 | 0.83549 | 0.83389 | 0.83228 | 0.83066 | 0.82904 | 56 |
| 34 | 0.82904 | 0.82741 | 0.82577 | 0.82413 | 0.82248 | 0.82082 | 0.81915 | 55 |
| 35 | 0.81915 | 0.81748 | 0.81580 | 0.81412 | 0.81242 | 0.81072 | 0.80902 | 54 |
| 36 | 0.80902 | 0.80730 | 0.80558 | 0.80386 | 0.80212 | 0.80038 | 0.79864 | 53 |
| 37 | 0.79864 | 0.79688 | 0.79512 | 0.79335 | 0.79158 | 0.78980 | 0.78801 | 52 |
| 38 | 0.78801 | 0.78622 | 0.78442 | 0.78261 | 0.78079 | 0.77897 | 0.77715 | 51 |
| 39 | 0.77715 | 0.77531 | 0.77347 | 0.77162 | 0.76977 | 0.76791 | 0.76604 | 50 |
| 40 | 0.76604 | 0.76417 | 0.76229 | 0.76041 | 0.75851 | 0.75661 | 0.75471 | 49 |
| 41 | 0.75471 | 0.75280 | 0.75088 | 0.74896 | 0.74703 | 0.74509 | 0.74314 | 48 |
| 42 | 0.74314 | 0.74120 | 0.73924 | 0.73728 | 0.73531 | 0.73333 | 0.73135 | 47 |
| 43 | 0.73135 | 0.72937 | 0.72737 | 0.72537 | 0.72337 | 0.72136 | 0.71934 | 46 |
| 44 | 0.71934 | 0.71732 | 0.71529 | 0.71325 | 0.71121 | 0.70916 | 0.70711 | 45 |
| Cosines | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | Degrees |
| | Sines | | | | | | | |

# NATURAL TANGENTS AND COTANGENTS

| Degrees | Tangents 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | Cotangents |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.00000 | 0.00291 | 0.00582 | 0.00873 | 0.01164 | 0.01455 | 0.01746 | 89 |
| 1 | 0.01746 | 0.02036 | 0.02328 | 0.02619 | 0.02910 | 0.03201 | 0.03492 | 88 |
| 2 | 0.03492 | 0.03783 | 0.04075 | 0.04366 | 0.04658 | 0.04949 | 0.05241 | 87 |
| 3 | 0.05241 | 0.05533 | 0.05824 | 0.06116 | 0.06408 | 0.06700 | 0.06993 | 86 |
| 4 | 0.06993 | 0.07285 | 0.07578 | 0.07870 | 0.08163 | 0.08456 | 0.08749 | 85 |
| 5 | 0.08749 | 0.09042 | 0.09335 | 0.09629 | 0.09923 | 0.10216 | 0.10510 | 84 |
| 6 | 0.10510 | 0.10805 | 0.11099 | 0.11394 | 0.11688 | 0.11983 | 0.12278 | 83 |
| 7 | 0.12278 | 0.12574 | 0.12869 | 0.13165 | 0.13461 | 0.13758 | 0.14054 | 82 |
| 8 | 0.14054 | 0.14351 | 0.14648 | 0.14945 | 0.15243 | 0.15540 | 0.15838 | 81 |
| 9 | 0.15838 | 0.16137 | 0.16435 | 0.16734 | 0.17033 | 0.17333 | 0.17633 | 80 |
| 10 | 0.17633 | 0.17933 | 0.18233 | 0.18534 | 0.18835 | 0.19136 | 0.19438 | 79 |
| 11 | 0.19438 | 0.19740 | 0.20042 | 0.20345 | 0.20648 | 0.20952 | 0.21256 | 78 |
| 12 | 0.21256 | 0.21560 | 0.21864 | 0.22169 | 0.22475 | 0.22781 | 0.23087 | 77 |
| 13 | 0.23087 | 0.23393 | 0.23700 | 0.24008 | 0.24316 | 0.24624 | 0.24933 | 76 |
| 14 | 0.24933 | 0.25242 | 0.25552 | 0.25862 | 0.26172 | 0.26483 | 0.26795 | 75 |
| 15 | 0.26795 | 0.27107 | 0.27419 | 0.27732 | 0.28046 | 0.28360 | 0.28675 | 74 |
| 16 | 0.28675 | 0.28990 | 0.29305 | 0.29621 | 0.29938 | 0.30255 | 0.30573 | 73 |
| 17 | 0.30573 | 0.30891 | 0.31210 | 0.31530 | 0.31850 | 0.32171 | 0.32492 | 72 |
| 18 | 0.32492 | 0.32814 | 0.33136 | 0.33460 | 0.33783 | 0.34108 | 0.34433 | 71 |
| 19 | 0.34433 | 0.34758 | 0.35085 | 0.35412 | 0.35740 | 0.36068 | 0.36397 | 70 |
| 20 | 0.36397 | 0.36727 | 0.37057 | 0.37388 | 0.37720 | 0.38053 | 0.38386 | 69 |
| 21 | 0.38386 | 0.38721 | 0.39055 | 0.39391 | 0.39727 | 0.40065 | 0.40403 | 68 |
| 22 | 0.40403 | 0.40741 | 0.41081 | 0.41421 | 0.41763 | 0.42105 | 0.42447 | 67 |
| 23 | 0.42447 | 0.42791 | 0.43136 | 0.43481 | 0.43828 | 0.44175 | 0.44523 | 66 |
| 24 | 0.44523 | 0.44872 | 0.45222 | 0.45573 | 0.45924 | 0.46277 | 0.46631 | 65 |
| 25 | 0.46631 | 0.46985 | 0.47341 | 0.47698 | 0.48055 | 0.48414 | 0.48773 | 64 |
| 26 | 0.48773 | 0.49134 | 0.49495 | 0.49858 | 0.50222 | 0.50587 | 0.50953 | 63 |
| 27 | 0.50953 | 0.51320 | 0.51688 | 0.52057 | 0.52427 | 0.52798 | 0.53171 | 62 |
| 28 | 0.53171 | 0.53545 | 0.53920 | 0.54296 | 0.54674 | 0.55051 | 0.55431 | 61 |
| 29 | 0.55431 | 0.55812 | 0.56194 | 0.56577 | 0.56962 | 0.57348 | 0.57735 | 60 |
| 30 | 0.57735 | 0.58124 | 0.58513 | 0.58905 | 0.59297 | 0.59691 | 0.60086 | 59 |
| 31 | 0.60086 | 0.60483 | 0.60881 | 0.61280 | 0.61681 | 0.62083 | 0.62487 | 58 |
| 32 | 0.62487 | 0.62892 | 0.63299 | 0.63707 | 0.64117 | 0.64528 | 0.64941 | 57 |
| 33 | 0.64941 | 0.65355 | 0.65771 | 0.66189 | 0.66608 | 0.67028 | 0.67451 | 56 |
| 34 | 0.67451 | 0.67875 | 0.68301 | 0.68728 | 0.69157 | 0.69588 | 0.70021 | 55 |
| 35 | 0.70021 | 0.70455 | 0.70891 | 0.71329 | 0.71769 | 0.72211 | 0.72654 | 54 |
| 36 | 0.72654 | 0.73100 | 0.73547 | 0.73996 | 0.74447 | 0.74900 | 0.75355 | 53 |
| 37 | 0.75355 | 0.75812 | 0.76272 | 0.76733 | 0.77196 | 0.77661 | 0.78129 | 52 |
| 38 | 0.78129 | 0.78598 | 0.79070 | 0.79544 | 0.80020 | 0.80498 | 0.80978 | 51 |
| 39 | 0.80978 | 0.81461 | 0.81946 | 0.82434 | 0.82923 | 0.83415 | 0.83910 | 50 |
| 40 | 0.83910 | 0.84407 | 0.84906 | 0.85408 | 0.85912 | 0.86419 | 0.86929 | 49 |
| 41 | 0.86929 | 0.87441 | 0.87955 | 0.88473 | 0.88992 | 0.89515 | 0.90040 | 48 |
| 42 | 0.90040 | 0.90569 | 0.91099 | 0.91633 | 0.92170 | 0.92709 | 0.93252 | 47 |
| 43 | 0.93252 | 0.93797 | 0.94345 | 0.94896 | 0.95451 | 0.96008 | 0.96569 | 46 |
| 44 | 0.96569 | 0.97133 | 0.97700 | 0.98270 | 0.98843 | 0.99420 | 1.00000 | 45 |
| Tangents | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | Degrees |
| | Cotangents | | | | | | | |

# NATURAL TANGENTS AND COTANGENTS

| Degrees | Cotangents 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | Tangents |
|---|---|---|---|---|---|---|---|---|
| 0 | ∝ | 343.77371 | 171.88540 | 114.58865 | 85.93979 | 68.75009 | 57.28996 | 89 |
| 1 | 57.28996 | 49.10388 | 42.96408 | 38.18846 | 34.36777 | 31.24158 | 28.63625 | 88 |
| 2 | 28.63625 | 26.43160 | 24.54176 | 22.90377 | 21.47040 | 20.20555 | 19.08114 | 87 |
| 3 | 19.08114 | 18.07498 | 17.16934 | 16.34986 | 15.60478 | 14.92442 | 14.30067 | 86 |
| 4 | 14.30067 | 13.72674 | 13.19688 | 12.70621 | 12.25051 | 11.82617 | 11.43005 | 85 |
| 5 | 11.43005 | 11.05943 | 10.71191 | 10.38540 | 10.07803 | 9.78817 | 9.51436 | 84 |
| 6 | 9.51436 | 9.25530 | 9.00983 | 8.77689 | 8.55555 | 8.34496 | 8.14435 | 83 |
| 7 | 8.14435 | 7.95302 | 7.77035 | 7.59575 | 7.42871 | 7.26873 | 7.11537 | 82 |
| 8 | 7.11537 | 6.96823 | 6.82694 | 6.69116 | 6.56055 | 6.43484 | 6.31375 | 81 |
| 9 | 6.31375 | 6.19703 | 6.08444 | 5.97576 | 5.87080 | 5.76937 | 5.67128 | 80 |
| 10 | 5.67128 | 5.57638 | 5.48451 | 5.39552 | 5.30928 | 5.22566 | 5.14455 | 79 |
| 11 | 5.14455 | 5.06584 | 4.98940 | 4.91516 | 4.84300 | 4.77286 | 4.70463 | 78 |
| 12 | 4.70463 | 4.63825 | 4.57363 | 4.51071 | 4.44942 | 4.38969 | 4.33148 | 77 |
| 13 | 4.33148 | 4.27471 | 4.21933 | 4.16530 | 4.11256 | 4.06107 | 4.01078 | 76 |
| 14 | 4.01078 | 3.96165 | 3.91364 | 3.86671 | 3.82083 | 3.77595 | 3.73205 | 75 |
| 15 | 3.73205 | 3.68909 | 3.64705 | 3.60588 | 3.56557 | 3.52609 | 3.48741 | 74 |
| 16 | 3.48741 | 3.44951 | 3.41236 | 3.37594 | 3.34023 | 3.30521 | 3.27085 | 73 |
| 17 | 3.27085 | 3.23714 | 3.20406 | 3.17159 | 3.13972 | 3.10842 | 3.07768 | 72 |
| 18 | 3.07768 | 3.04749 | 3.01783 | 2.98869 | 2.96004 | 2.93189 | 2.90421 | 71 |
| 19 | 2.90421 | 2.87700 | 2.85023 | 2.82391 | 2.79802 | 2.77254 | 2.74748 | 70 |
| 20 | 2.74748 | 2.72281 | 2.69853 | 2.67462 | 2.65109 | 2.62791 | 2.60509 | 69 |
| 21 | 2.60509 | 2.58261 | 2.56046 | 2.53865 | 2.51715 | 2.49597 | 2.47509 | 68 |
| 22 | 2.47509 | 2.45451 | 2.43422 | 2.41421 | 2.39449 | 2.37504 | 2.35585 | 67 |
| 23 | 2.35585 | 2.33693 | 2.31826 | 2.29984 | 2.28167 | 2.26374 | 2.24604 | 66 |
| 24 | 2.24604 | 2.22857 | 2.21132 | 2.19430 | 2.17749 | 2.16090 | 2.14451 | 65 |
| 25 | 2.14451 | 2.12832 | 2.11233 | 2.09654 | 2.08094 | 2.06553 | 2.05030 | 64 |
| 26 | 2.05030 | 2.03526 | 2.02039 | 2.00569 | 1.99116 | 1.97680 | 1.96261 | 63 |
| 27 | 1.96261 | 1.94858 | 1.93470 | 1.92098 | 1.90741 | 1.89400 | 1.88073 | 62 |
| 28 | 1.88073 | 1.86760 | 1.85462 | 1.84177 | 1.82907 | 1.81649 | 1.80405 | 61 |
| 29 | 1.80405 | 1.79174 | 1.77955 | 1.76749 | 1.75556 | 1.74375 | 1.73205 | 60 |
| 30 | 1.73205 | 1.72047 | 1.70901 | 1.69766 | 1.68643 | 1.67530 | 1.66428 | 59 |
| 31 | 1.66428 | 1.65337 | 1.64256 | 1.63185 | 1.62125 | 1.61074 | 1.60033 | 58 |
| 32 | 1.60033 | 1.59002 | 1.57981 | 1.56969 | 1.55966 | 1.54972 | 1.53987 | 57 |
| 33 | 1.53987 | 1.53010 | 1.52043 | 1.51084 | 1.50133 | 1.49190 | 1.48256 | 56 |
| 34 | 1.48256 | 1.47330 | 1.46411 | 1.45501 | 1.44598 | 1.43703 | 1.42815 | 55 |
| 35 | 1.42815 | 1.41934 | 1.41061 | 1.40195 | 1.39336 | 1.38484 | 1.37638 | 54 |
| 36 | 1.37638 | 1.36800 | 1.35968 | 1.35142 | 1.34323 | 1.33511 | 1.32704 | 53 |
| 37 | 1.32704 | 1.31904 | 1.31110 | 1.30323 | 1.29541 | 1.28764 | 1.27994 | 52 |
| 38 | 1.27994 | 1.27230 | 1.26471 | 1.25717 | 1.24969 | 1.24227 | 1.23490 | 51 |
| 39 | 1.23490 | 1.22758 | 1.22031 | 1.21310 | 1.20593 | 1.19882 | 1.19175 | 50 |
| 40 | 1.19175 | 1.18474 | 1.17777 | 1.17085 | 1.16398 | 1.15715 | 1.15037 | 49 |
| 41 | 1.15037 | 1.14363 | 1.13694 | 1.13029 | 1.12369 | 1.11713 | 1.11061 | 48 |
| 42 | 1.11061 | 1.10414 | 1.09770 | 1.09131 | 1.08496 | 1.07864 | 1.07237 | 47 |
| 43 | 1.07237 | 1.06613 | 1.05994 | 1.05378 | 1.04766 | 1.04158 | 1.03553 | 46 |
| 44 | 1.03553 | 1.02952 | 1.02355 | 1.01761 | 1.01170 | 1.00583 | 1.00000 | 45 |
| Cotangents | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | Degrees |
| | Tangents | | | | | | | |

# NATURAL SECANTS AND COSECANTS

| Degrees | Secants 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | Cosecants |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.00000 | 1.00000 | 1.00002 | 1.00004 | 1.00007 | 1.00011 | 1.00015 | 89 |
| 1 | 1.00015 | 1.00021 | 1.00027 | 1.00034 | 1.00042 | 1.00051 | 1.00061 | 88 |
| 2 | 1.00061 | 1.00072 | 1.00083 | 1.00095 | 1.00108 | 1.00122 | 1.00137 | 87 |
| 3 | 1.00137 | 1.00153 | 1.00169 | 1.00187 | 1.00205 | 1.00224 | 1.00244 | 86 |
| 4 | 1.00244 | 1.00265 | 1.00287 | 1.00309 | 1.00333 | 1.00357 | 1.00382 | 85 |
| 5 | 1.00382 | 1.00408 | 1.00435 | 1.00463 | 1.00491 | 1.00521 | 1.00551 | 84 |
| 6 | 1.00551 | 1.00582 | 1.00614 | 1.00647 | 1.00681 | 1.00715 | 1.00751 | 83 |
| 7 | 1.00751 | 1.00787 | 1.00825 | 1.00863 | 1.00902 | 1.00942 | 1.00983 | 82 |
| 8 | 1.00983 | 1.01024 | 1.01067 | 1.01111 | 1.01155 | 1.01200 | 1.01247 | 81 |
| 9 | 1.01247 | 1.01294 | 1.01342 | 1.01391 | 1.01440 | 1.01491 | 1.01543 | 80 |
| 10 | 1.01543 | 1.01595 | 1.01649 | 1.01703 | 1.01758 | 1.01815 | 1.01872 | 79 |
| 11 | 1.01872 | 1.01930 | 1.01989 | 1.02049 | 1.02110 | 1.02171 | 1.02234 | 78 |
| 12 | 1.02234 | 1.02298 | 1.02362 | 1.02428 | 1.02494 | 1.02562 | 1.02630 | 77 |
| 13 | 1.02630 | 1.02700 | 1.02770 | 1.02842 | 1.02914 | 1.02987 | 1.03061 | 76 |
| 14 | 1.03061 | 1.03137 | 1.03213 | 1.03290 | 1.03368 | 1.03447 | 1.03528 | 75 |
| 15 | 1.03528 | 1.03609 | 1.03691 | 1.03774 | 1.03858 | 1.03944 | 1.04030 | 74 |
| 16 | 1.04030 | 1.04117 | 1.04206 | 1.04295 | 1.04385 | 1.04477 | 1.04569 | 73 |
| 17 | 1.04569 | 1.04663 | 1.04757 | 1.04853 | 1.04950 | 1.05047 | 1.05146 | 72 |
| 18 | 1.05146 | 1.05246 | 1.05347 | 1.05449 | 1.05552 | 1.05657 | 1.05762 | 71 |
| 19 | 1.05762 | 1.05869 | 1.05976 | 1.06085 | 1.06195 | 1.06306 | 1.06418 | 70 |
| 20 | 1.06418 | 1.06531 | 1.06645 | 1.06761 | 1.06878 | 1.06995 | 1.07115 | 69 |
| 21 | 1.07115 | 1.07235 | 1.07356 | 1.07479 | 1.07602 | 1.07727 | 1.07853 | 68 |
| 22 | 1.07853 | 1.07981 | 1.08109 | 1.08239 | 1.08370 | 1.08503 | 1.08636 | 67 |
| 23 | 1.08636 | 1.08771 | 1.08907 | 1.09044 | 1.09183 | 1.09323 | 1.09464 | 66 |
| 24 | 1.09464 | 1.09606 | 1.09750 | 1.09895 | 1.10041 | 1.10189 | 1.10338 | 65 |
| 25 | 1.10338 | 1.10488 | 1.10640 | 1.10793 | 1.10947 | 1.11103 | 1.11260 | 64 |
| 26 | 1.11260 | 1.11419 | 1.11579 | 1.11740 | 1.11903 | 1.12067 | 1.12233 | 63 |
| 27 | 1.12233 | 1.12400 | 1.12568 | 1.12738 | 1.12910 | 1.13083 | 1.13257 | 62 |
| 28 | 1.13257 | 1.13433 | 1.13610 | 1.13789 | 1.13970 | 1.14152 | 1.14335 | 61 |
| 29 | 1.14335 | 1.14521 | 1.14707 | 1.14896 | 1.15085 | 1.15277 | 1 15470 | 60 |
| 30 | 1.15470 | 1.15665 | 1.15861 | 1.16059 | 1.16259 | 1.16460 | 1 16663 | 59 |
| 31 | 1.16663 | 1.16868 | 1.17075 | 1.17283 | 1.17493 | 1.17704 | 1.17918 | 58 |
| 32 | 1.17918 | 1.18133 | 1.18350 | 1.18569 | 1.18790 | 1.19012 | 1.19236 | 57 |
| 33 | 1.19236 | 1.19463 | 1.19691 | 1.19920 | 1.20152 | 1.20386 | 1.20622 | 56 |
| 34 | 1.20622 | 1.20859 | 1.21099 | 1.21341 | 1.21584 | 1.21830 | 1.22077 | 55 |
| 35 | 1.22077 | 1.22327 | 1.22579 | 1.22833 | 1.23089 | 1.23347 | 1.23607 | 54 |
| 36 | 1.23607 | 1.23869 | 1.24134 | 1.24400 | 1.24669 | 1.24940 | 1.25214 | 53 |
| 37 | 1.25214 | 1.25489 | 1.25767 | 1.26047 | 1.26330 | 1.26615 | 1.26902 | 52 |
| 38 | 1.26902 | 1.27191 | 1.27483 | 1.27778 | 1.28075 | 1.28374 | 1.28676 | 51 |
| 39 | 1.28676 | 1.28980 | 1.29287 | 1.29597 | 1.29909 | 1.30223 | 1.30541 | 50 |
| 40 | 1.30541 | 1.30861 | 1.31183 | 1.31509 | 1.31837 | 1.32168 | 1.32501 | 49 |
| 41 | 1.32501 | 1.32838 | 1.33177 | 1.33519 | 1.33864 | 1.34212 | 1.34563 | 48 |
| 42 | 1.34563 | 1.34917 | 1.35274 | 1.35634 | 1.35997 | 1.36363 | 1.36733 | 47 |
| 43 | 1.36733 | 1.37105 | 1.37481 | 1.37860 | 1.38242 | 1.38628 | 1.39016 | 46 |
| 44 | 1.39016 | 1.39409 | 1.39804 | 1.40203 | 1.40606 | 1.41012 | 1.41421 | 45 |
| Secants | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | Degrees |
| | Cosecants | | | | | | | |

# NATURAL SECANTS AND COSECANTS

| Degrees | Cosecants 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | Secants |
|---|---|---|---|---|---|---|---|---|
| 0 | ∝ | 343.77516 | 171.88831 | 114.59301 | 85.94561 | 68.75736 | 57.29869 | 89 |
| 1 | 57.29869 | 49.11406 | 42.97571 | 38.20155 | 34.38232 | 31.25758 | 28.65371 | 88 |
| 2 | 28.65371 | 26.45051 | 24.56212 | 22.92559 | 21.49368 | 20.23028 | 19.10732 | 87 |
| 3 | 19.10732 | 18.10262 | 17.19843 | 16.38041 | 15.63679 | 14.95788 | 14.33559 | 86 |
| 4 | 14.33559 | 13.76312 | 13.23472 | 12.74550 | 12.29125 | 11.86837 | 11.47371 | 85 |
| 5 | 11.47371 | 11.10455 | 10.75849 | 10.43343 | 10.12752 | 9.83912 | 9.56677 | 84 |
| 6 | 9.56677 | 9.30917 | 9.06515 | 8.83367 | 8.61379 | 8.40466 | 8.20551 | 83 |
| 7 | 8.20551 | 8.01565 | 7.83443 | 7.66130 | 7.49571 | 7.33719 | 7.18530 | 82 |
| 8 | 7.18530 | 7.03962 | 6.89979 | 6.76547 | 6.63633 | 6.51208 | 6.39245 | 81 |
| 9 | 6.39245 | 6.27719 | 6.16607 | 6.05886 | 5.95536 | 5.85539 | 5.75877 | 80 |
| 10 | 5.75877 | 5.66533 | 5.57493 | 5.48740 | 5.40263 | 5.32049 | 5.24084 | 79 |
| 11 | 5.24084 | 5.16359 | 5.08863 | 5.01585 | 4.94517 | 4.87649 | 4.80973 | 78 |
| 12 | 4.80973 | 4.74482 | 4.68167 | 4.62023 | 4.56041 | 4.50216 | 4.44541 | 77 |
| 13 | 4.44541 | 4.39012 | 4.33622 | 4.28366 | 4.23239 | 4.18238 | 4.13357 | 76 |
| 14 | 4.13357 | 4.08591 | 4.03938 | 3.99393 | 3.94952 | 3.90613 | 3.86370 | 75 |
| 15 | 3.86370 | 3.82223 | 3.78166 | 3.74198 | 3.70315 | 3.66515 | 3.62796 | 74 |
| 16 | 3.62796 | 3.59154 | 3.55587 | 3.52094 | 3.48671 | 3.45317 | 3.42030 | 73 |
| 17 | 3.42030 | 3.38808 | 3.35649 | 3.32551 | 3.29512 | 3.26531 | 3.23607 | 72 |
| 18 | 3.23607 | 3.20737 | 3.17920 | 3.15155 | 3.12440 | 3.09774 | 3.07155 | 71 |
| 19 | 3.07155 | 3.04584 | 3.02057 | 2.99574 | 2.97135 | 2.94737 | 2.92380 | 70 |
| 20 | 2.92380 | 2.90063 | 2.87785 | 2.85545 | 2.83342 | 2.81175 | 2.79043 | 69 |
| 21 | 2.79043 | 2.76945 | 2.74881 | 2.72850 | 2.70851 | 2.68884 | 2.66947 | 68 |
| 22 | 2.66947 | 2.65040 | 2.63162 | 2.61313 | 2.59491 | 2.57698 | 2.55930 | 67 |
| 23 | 2.55930 | 2.54190 | 2.52474 | 2.50784 | 2.49119 | 2.47477 | 2.45859 | 66 |
| 24 | 2.45859 | 2.44264 | 2.42692 | 2.41142 | 2.39614 | 2.38107 | 2.36620 | 65 |
| 25 | 2.36620 | 2.35154 | 2.33708 | 2.32282 | 2.30875 | 2.29487 | 2.28117 | 64 |
| 26 | 2.28117 | 2.26766 | 2.25432 | 2.24116 | 2.22817 | 2.21535 | 2.20269 | 63 |
| 27 | 2.20269 | 2.19019 | 2.17786 | 2.16568 | 2.15366 | 2.14178 | 2.13005 | 62 |
| 28 | 2.13005 | 2.11847 | 2.10704 | 2.09574 | 2.08458 | 2.07356 | 2.06267 | 61 |
| 29 | 2.06267 | 2.05191 | 2.04128 | 2.03077 | 2.02039 | 2.01014 | 2.00000 | 60 |
| 30 | 2.00000 | 1.98998 | 1.98008 | 1.97029 | 1.96062 | 1.95106 | 1.94160 | 59 |
| 31 | 1.94160 | 1.93226 | 1.92302 | 1.91388 | 1.90485 | 1.89591 | 1.88709 | 58 |
| 32 | 1.88708 | 1.87834 | 1.86970 | 1.86116 | 1.85271 | 1.84435 | 1.83608 | 57 |
| 33 | 1.83608 | 1.82790 | 1.81981 | 1.81180 | 1.80388 | 1.79604 | 1.78829 | 56 |
| 34 | 1.78829 | 1.78062 | 1.77303 | 1.76552 | 1.75808 | 1.75073 | 1.74345 | 55 |
| 35 | 1.74345 | 1.73624 | 1.72911 | 1.72205 | 1.71506 | 1.70815 | 1.70130 | 54 |
| 36 | 1.70130 | 1.69452 | 1.68782 | 1.68117 | 1.67460 | 1.66809 | 1.66164 | 53 |
| 37 | 1.66164 | 1.65526 | 1.64894 | 1.64268 | 1.63648 | 1.63035 | 1.62427 | 52 |
| 38 | 1.62427 | 1.61825 | 1.61229 | 1.60639 | 1.60054 | 1.59475 | 1.58902 | 51 |
| 39 | 1.58902 | 1.58333 | 1.57771 | 1.57213 | 1.56661 | 1.56114 | 1.55572 | 50 |
| 40 | 1.55572 | 1.55036 | 1.54504 | 1.53977 | 1.53455 | 1.52938 | 1.52425 | 49 |
| 41 | 1.52425 | 1.51918 | 1.51415 | 1.50916 | 1.50422 | 1.49933 | 1.49448 | 48 |
| 42 | 1.49448 | 1.48967 | 1.48491 | 1.48019 | 1.47551 | 1.47087 | 1.46628 | 47 |
| 43 | 1.46628 | 1.46173 | 1.45721 | 1.45274 | 1.44831 | 1.44391 | 1.43956 | 46 |
| 44 | 1.43956 | 1.43524 | 1.43096 | 1.42672 | 1.42251 | 1.41835 | 1.41421 | 45 |

| Cosecants | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | Degrees |
|---|---|---|---|---|---|---|---|---|
| | Secants | | | | | | | |

# LENGTH OF CIRCULAR ARCS FOR THE RADIUS 1

| DEGREES | | | | | | MINUTES | | SECONDS | |
|---|---|---|---|---|---|---|---|---|---|
| 0° | 0.000 0000 | 60° | 1.047 1976 | 120° | 2.094 3951 | 0′ | 0.000 0000 | 0″ | 0.000 0000 |
| 1 | 0.017 4533 | 61 | 1.064 6508 | 121 | 2.111 8484 | 1 | 0.000 2909 | 1 | 0.000 0048 |
| 2 | 0.034 9066 | 62 | 1.082 1041 | 122 | 2.129 3017 | 2 | 0.000 5818 | 2 | 0.000 0097 |
| 3 | 0.052 3599 | 63 | 1.099 5574 | 123 | 2.146 7550 | 3 | 0.000 8727 | 3 | 0.000 0145 |
| 4 | 0.069 8132 | 64 | 1.117 0107 | 124 | 2.164 2083 | 4 | 0.001 1636 | 4 | 0.000 0194 |
| 5 | 0.087 2665 | 65 | 1.134 4640 | 125 | 2.181 6616 | 5 | 0.001 4544 | 5 | 0.000 0242 |
| 6 | 0.104 7198 | 66 | 1.151 9173 | 126 | 2.199 1149 | 6 | 0.001 7453 | 6 | 0.000 0291 |
| 7 | 0.122 1730 | 67 | 1.169 3706 | 127 | 2.216 5682 | 7 | 0.002 0362 | 7 | 0.000 0339 |
| 8 | 0.139 6263 | 68 | 1.186 8239 | 128 | 2.234 0214 | 8 | 0.002 3271 | 8 | 0.000 0388 |
| 9 | 0.157 0796 | 69 | 1.204 2772 | 129 | 2.251 4747 | 9 | 0.002 6180 | 9 | 0.000 0436 |
| 10 | 0.174 5329 | 70 | 1.221 7305 | 130 | 2.268 9280 | 10 | 0.002 9089 | 10 | 0.000 0485 |
| 11 | 0.191 9862 | 71 | 1.239 1838 | 131 | 2.286 3813 | 11 | 0.003 1998 | 11 | 0.000 0533 |
| 12 | 0.209 4395 | 72 | 1.256 6371 | 132 | 2.303 8346 | 12 | 0.003 4907 | 12 | 0.000 0582 |
| 13 | 0 226 8928 | 73 | 1.274 0904 | 133 | 2.321 2879 | 13 | 0.003 7815 | 13 | 0.000 0630 |
| 14 | 0.244 3461 | 74 | 1.291 5436 | 134 | 2.338 7412 | 14 | 0.004 0724 | 14 | 0.000 0679 |
| 15 | 0.261 7994 | 75 | 1.308 9969 | 135 | 2.356 1945 | 15 | 0.004 3633 | 15 | 0.000 0727 |
| 16 | 0.279 2527 | 76 | 1.326 4502 | 136 | 2.373 6478 | 16 | 0.004 6542 | 16 | 0.000 0776 |
| 17 | 0.296 7060 | 77 | 1.343 9035 | 137 | 2.391 1011 | 17 | 0.004 9451 | 17 | 0.000 0824 |
| 18 | 0.314 1593 | 78 | 1.361 3568 | 138 | 2.408 5544 | 18 | 0.005 2360 | 18 | 0.000 0873 |
| 19 | 0.331 6126 | 79 | 1.378 8101 | 139 | 2.426 0077 | 19 | 0.005 5269 | 19 | 0.000 0921 |
| 20 | 0.349 0659 | 80 | 1.396 2634 | 140 | 2.443 4610 | 20 | 0.005 8178 | 20 | 0.000 0970 |
| 21 | 0.366 5191 | 81 | 1.413 7167 | 141 | 2.460 9142 | 21 | 0.006 1087 | 21 | 0.000 1018 |
| 22 | 0.383 9724 | 82 | 1.431 1700 | 142 | 2.478 3675 | 22 | 0.006 3995 | 22 | 0.000 1067 |
| 23 | 0.401 4257 | 83 | 1.448 6233 | 143 | 2.495 8208 | 23 | 0.006 6904 | 23 | 0.000 1115 |
| 24 | 0.418 8790 | 84 | 1.466 0766 | 144 | 2.513 2741 | 24 | 0.006 9813 | 24 | 0.000 1164 |
| 25 | 0.436 3323 | 85 | 1.483 5299 | 145 | 2.530 7274 | 25 | 0.007 2722 | 25 | 0.000 1212 |
| 26 | 0.453 7856 | 86 | 1.500 9832 | 146 | 2.548 1807 | 26 | 0.007 5631 | 26 | 0.000 1261 |
| 27 | 0.471 2389 | 87 | 1.518 4364 | 147 | 2.565 6340 | 27 | 0.007 8540 | 27 | 0.000 1309 |
| 28 | 0.488 6922 | 88 | 1.535 8897 | 148 | 2.583 0873 | 28 | 0.008 1449 | 28 | 0.000 1357 |
| 29 | 0.506 1455 | 89 | 1.553 3430 | 149 | 2.600 5406 | 29 | 0.008 4358 | 29 | 0.000 1406 |
| 30 | 0.523 5988 | 90 | 1.570 7963 | 150 | 2.617 9939 | 30 | 0.008 7266 | 30 | 0.000 1454 |
| 31 | 0.541 0521 | 91 | 1.588 2496 | 151 | 2.635 4472 | 31 | 0.009 0175 | 31 | 0.000 1503 |
| 32 | 0.558 5054 | 92 | 1.605 7029 | 152 | 2.652 9005 | 32 | 0.009 3084 | 32 | 0.000 1551 |
| 33 | 0.575 9587 | 93 | 1.623 1562 | 153 | 2.670 3538 | 33 | 0.009 5993 | 33 | 0.000 1600 |
| 34 | 0.593 4119 | 94 | 1.640 6095 | 154 | 2.687 8070 | 34 | 0.009 8902 | 34 | 0.000 1648 |
| 35 | 0.610 8652 | 95 | 1.658 0628 | 155 | 2.705 2603 | 35 | 0.010 1811 | 35 | 0.000 1697 |
| 36 | 0.628 3185 | 96 | 1.675 5161 | 156 | 2.722 7136 | 36 | 0.010 4720 | 36 | 0.000 1745 |
| 37 | 0.645 7718 | 97 | 1.692 9694 | 157 | 2.740 1669 | 37 | 0.010 7629 | 37 | 0.000 1794 |
| 38 | 0.663 2251 | 98 | 1.710 4227 | 158 | 2.757 6202 | 38 | 0.011 0538 | 38 | 0.000 1842 |
| 39 | 0.680 6784 | 99 | 1.727 8760 | 159 | 2.775 0735 | 39 | 0.011 3446 | 39 | 0.000 1891 |
| 40 | 0.698 1317 | 100 | 1.745 3293 | 160 | 2.792 5268 | 40 | 0.011 6355 | 40 | 0.000 1939 |
| 41 | 0.715 5850 | 101 | 1.762 7825 | 161 | 2.809 9801 | 41 | 0.011 9264 | 41 | 0.000 1988 |
| 42 | 0.733 0383 | 102 | 1.780 2358 | 162 | 2.827 4334 | 42 | 0.012 2173 | 42 | 0.000 2036 |
| 43 | 0.750 4916 | 103 | 1.797 6891 | 163 | 2.844 8867 | 43 | 0.012 5082 | 43 | 0.000 2085 |
| 44 | 0.767 9449 | 104 | 1.815 1424 | 164 | 2.862 3400 | 44 | 0.012 7991 | 44 | 0.000 2133 |
| 45 | 0.785 3982 | 105 | 1.832 5957 | 165 | 2.879 7933 | 45 | 0.013 0900 | 45 | 0.000 2182 |
| 46 | 0.802 8515 | 106 | 1.850 0490 | 166 | 2.897 2466 | 46 | 0.013 3809 | 46 | 0.000 2230 |
| 47 | 0.820 3047 | 107 | 1.867 5023 | 167 | 2.914 6999 | 47 | 0.013 6717 | 47 | 0.000 2279 |
| 48 | 0.837 7580 | 108 | 1.884 9556 | 168 | 2.932 1531 | 48 | 0.013 9626 | 48 | 0.000 2327 |
| 49 | 0.855 2113 | 109 | 1.902 4089 | 169 | 2.949 6064 | 49 | 0.014 2535 | 49 | 0.000 2376 |
| 50 | 0.872 6646 | 110 | 1.919 8622 | 170 | 2.967 0597 | 50 | 0.014 5444 | 50 | 0.000 2424 |
| 51 | 0.890 1179 | 111 | 1.937 3155 | 171 | 2.984 5130 | 51 | 0 014 8353 | 51 | 0.000 2473 |
| 52 | 0.907 5712 | 112 | 1.954 7688 | 172 | 3.001 9663 | 52 | 0 015 1262 | 52 | 0.000 2521 |
| 53 | 0.925 0245 | 113 | 1.972 2221 | 173 | 3.019 4196 | 53 | 0.015 4171 | 53 | 0.000 2570 |
| 54 | 0.942 4778 | 114 | 1.989 6753 | 174 | 3.036 8729 | 54 | 0.015 7080 | 54 | 0.000 2618 |
| 55 | 0.959 9311 | 115 | 2.007 1286 | 175 | 3.054 3262 | 55 | 0 015 9989 | 55 | 0.000 2666 |
| 56 | 0.977 3844 | 116 | 2.024 5819 | 176 | 3.071 7795 | 56 | 0 016 2897 | 56 | 0.000 2715 |
| 57 | 0.994 8377 | 117 | 2.042 0352 | 177 | 3.089 2328 | 57 | 0.016 5806 | 57 | 0.000 2763 |
| 58 | 1.012 2910 | 118 | 2.059 4885 | 178 | 3.106 6861 | 58 | 0.016 8715 | 58 | 0.000 2812 |
| 59 | 1.029 7443 | 119 | 2.076 9418 | 179 | 3.124 1394 | 59 | 0.017 1624 | 59 | 0.000 2860 |
| 60 | 1.047 1976 | 120 | 2.094 3951 | 180 | 3.141 5927 | 60 | 0.017 4533 | 60 | 0.000 2909 |

By the use of the above table, the length of any arc may be found if the length of the radius and the angle of the segment be known.

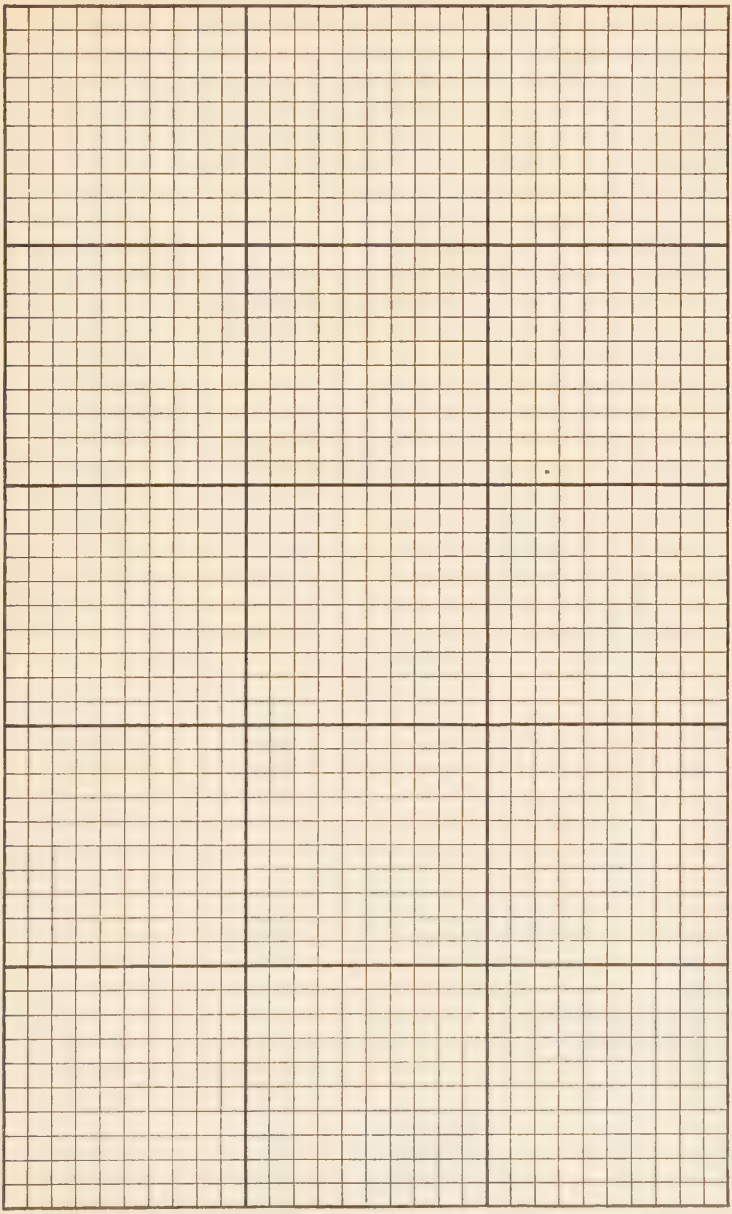
Example:— Required the length of arc of segment of 32° 15′ 27″ with radius of 24 feet 3 inches.

From table. Length of arc (Radius 1) for 32° = .5585054
15′ = .0043633
27″ = .0001309

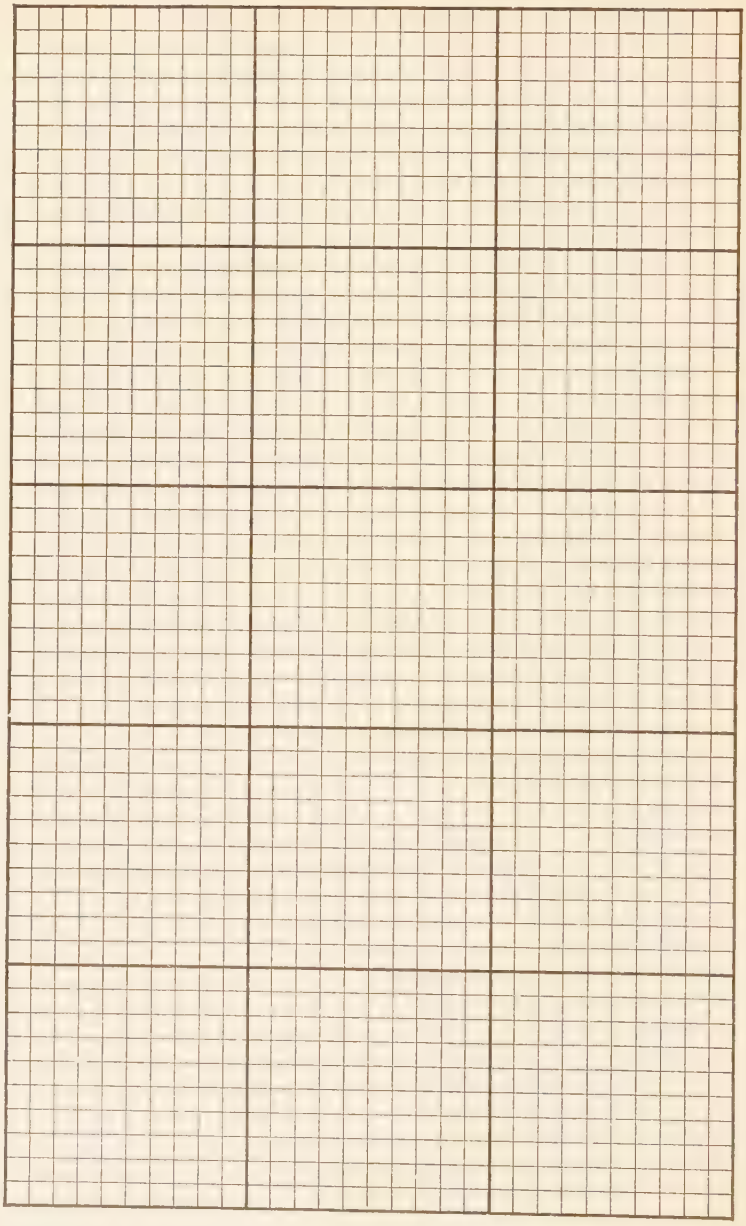
5629996

.5629996 × 24.25 (length of radius) = 13.65′ = Ans.

## NOTES and DIAGRAMS



## NOTES and DIAGRAMS



## NOTES and DIAGRAMS

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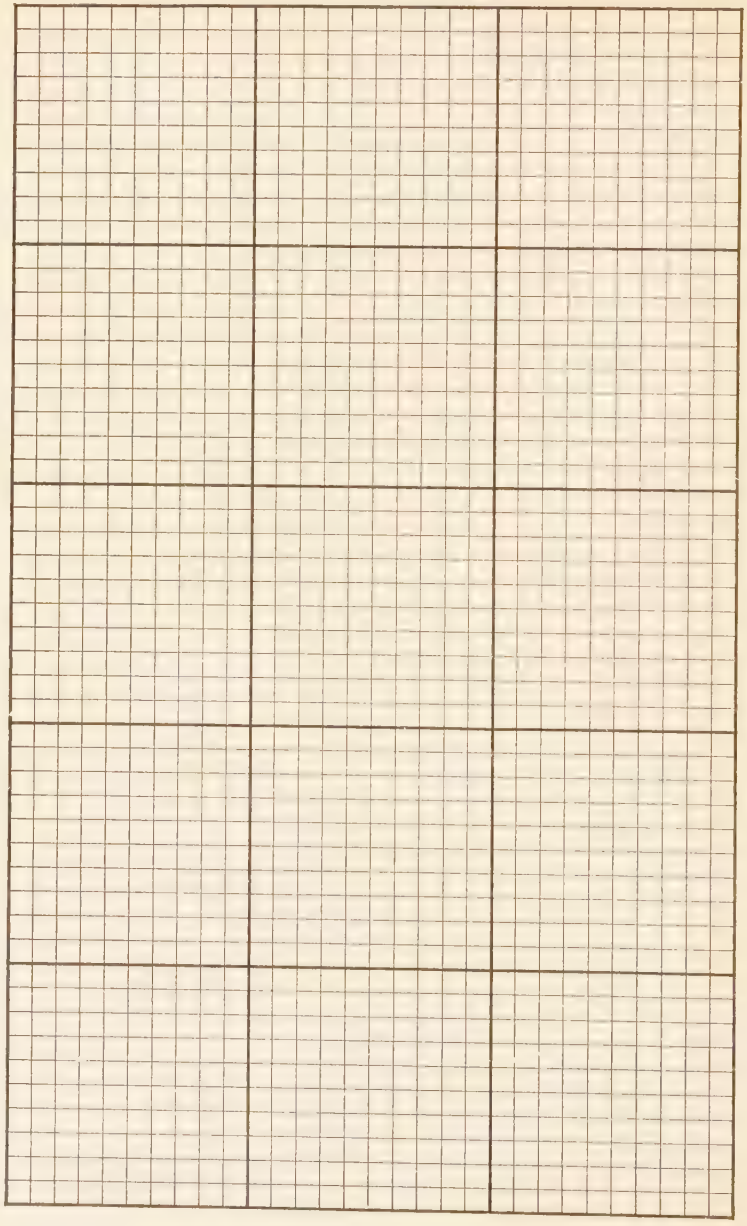


# Part III

## Building Materials

Strength of Materials

Specific Gravities

Properties of
American Standard Yard Lumber and Timber

Safe Loads for Timber Columns

Unit Stresses for Structural Lumber

Contents of Storage Warehouses

# STRENGTH OF MATERIALS

STRESS IN KIPS PER SQUARE INCH

| Metals and Alloys | Tension, Ultimate | Elastic Limit | Compression, Ultimate | Bending, Ultimate | Shearing, Ultimate | Modulus of Elasticity, Pounds | Elongation, % |
|---|---|---|---|---|---|---|---|
| Aluminum, cast | 15 | 6 5 | 12 | ..... | 12 | 11000000 | ..... |
| " bars, sheets | 24 28 | 12-14 | ..... | ..... | ..... | ..... | ..... |
| " wire, hard | 30-65 | 16-30 | ..... | ..... | ..... | ..... | ..... |
| " " annealed | 20-35 | 14 | ..... | ..... | ..... | ..... | ..... |
| " 2—7% Ni, Cu, Fe, etc | 40-50 | 25 | ..... | ..... | ..... | ..... | ..... |
| Aluminum Bronze, 5% to 7½% Al | 75 | 40 | 120 | ..... | ..... | ..... | ..... |
| " " 10% Al | 85-100 | 60 | ..... | ..... | ..... | ..... | ..... |
| Brass, 17% Zn | 32 6 | 8 2 | ..... | 23 2 | ..... | ..... | 26.7 |
| " 23% " | ..... | 7 6 | 42 | 22 3 | ..... | ..... | 35 8 |
| " 30% " | 28 1 | 8 6 | ..... | 26 9 | ..... | ..... | 20.7 |
| " 39% " | 41.1 | 17 4 | 75 | 39 | ..... | ..... | 20.7 |
| " 50% " | 31 | 17 9 | 117 | 33 5 | ..... | ..... | 5.0 |
| " cast, common | 18-24 | 6 | 30 | 20 | 36 | 9000000 | ..... |
| " wire, hard | 80 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " annealed | 50 | 16 | ..... | ..... | ..... | 14000000 | ..... |
| Bronze 8% Sn | 28 5 | 19 | 42 | 43 7 | ..... | 10000000 | 5 5 |
| " 13% " | 29 4 | 20 | 53 | 34 5 | ..... | ..... | 3 3 |
| " 20% " | 33 | ..... | 78 | 56 7 | ..... | ..... | 0.04 |
| " 24% " | 22 | 22 | 114 | 32 | ..... | ..... | 0 |
| " 30% " | 5 6 | 5 6 | 147 | 12 1 | ..... | ..... | 0 |
| " gun metal, 9 Cu, 1 Sn | 25-55 | 10 | ..... | 52 | ..... | 10000000 | ..... |
| " Manganese, cast } 10% Sn | 60 | 30 | 125 | ..... | ..... | ..... | ..... |
| " " rolled } 2% Mn | 100 | 80 | ..... | ..... | ..... | ..... | ..... |
| " Phosphorus, cast } 9% Sn | 50 | 24 | ..... | ..... | ..... | ..... | ..... |
| " " wire } 1% P | 100 | ..... | ..... | ..... | ..... | ..... | ..... |
| " Silicon, cast, 3% Si | 55 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " " 5% Si | 75 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " wire | 108 | ..... | ..... | ..... | ..... | ..... | ..... |
| " Tobin, cast } 38% Zn. | 66 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " rolled } 1½% Sn. | 80 | 40 | ..... | ..... | ..... | 4500000 | ..... |
| " " cold rolled } ½% Pb | 100 | ..... | ..... | ..... | ..... | ..... | ..... |
| Copper, cast | 25 | 6 | 40 | 22 | 30 | 10000000 | ..... |
| " plates, rods, bolts | 32-35 | 10 | 32 | ..... | ..... | ..... | ..... |
| " wire, hard | 55-65 | ..... | ..... | ..... | ..... | 18000000 | ..... |
| " wire, annealed | 36 | 10 | ..... | ..... | ..... | 15000000 | ..... |
| Delta Metal, cast } 55—60% Cu | 45 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " plates } 38—40% Zn | 68 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " bars } 2 – 4% Fe | 85 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " wire } 1 – 2% Sn | 100 | ..... | ..... | ..... | ..... | ..... | ..... |
| German Silver, 25% Zn, 20% Ni | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Gold, cast | 20 | 4 | ..... | ..... | ..... | 8000000 | ..... |
| " wire | 30 | ..... | ..... | ..... | ..... | ..... | ..... |
| " copper, 5 Au, 1 Cu | 50 | ..... | ..... | ..... | ..... | ..... | ..... |
| Iron, cast, common | 15-18 | 6 | 80 | 30 | 18-20 | 12000000 | ..... |
| " " gray | 18-24 | ..... | ..... | 25 33 | ..... | ..... | ..... |
| " " malleable | 27-35 | 15 20 | 46 | 30 | 40 | ..... | ..... |
| Iron, wrought, shapes | 48 | 26 | tensile | tensile | ⅝ tens. | 28000000 | ..... |
| " " bars | 50 | 27 | tensile | tensile | ⅝ tens. | 28000000 | ..... |
| " " wire, unannealed | 80 | ..... | ..... | ..... | ..... | 15000000 | ..... |
| " " " annealed | 60 | 27 | ..... | ..... | ..... | 25000000 | ..... |
| Lead, cast | 1.8 | ..... | ..... | ..... | ..... | 1000000 | ..... |
| " pipe, wire | 2.2-2.5 | ..... | ..... | ..... | ..... | 1000000 | ..... |
| " rolled, sheets | 3.3 | ..... | ..... | ..... | ..... | 720000 | ..... |
| Platinum, wire, unannealed | 55 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " annealed | 32 | ..... | ..... | ..... | ..... | ..... | ..... |
| Silver, cast | 40 | ..... | ..... | ..... | ..... | ..... | ..... |
| Steel, boiler plates*, fire box | 55-65 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 27.3-23.0 |
| " " " flange plates | 52-62 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 28.8-24.2 |
| " castings*, soft | 60 | 27 | tensile | tensile | ¾ tens. | 29000000 | 22.0 |
| " " medium | 70 | 31.5 | tensile | tensile | ¾ tens. | 29000000 | 18.0 |
| " " hard | 80 | 36 | tensile | tensile | ¾ tens. | 29000000 | 15.0 |
| " reinforcing bars*, plain, structural grade | 55-70 | 33 | tensile | tensile | ¾ tens. | 29000000 | 25.4-20.0 |
| " " " " intermediate | 70-85 | 40 | tensile | tensile | ¾ tens. | 29000000 | 18.6-15.3 |
| " " " " hard | 80 | 50 | tensile | tensile | ¾ tens. | 29000000 | 15 0 |
| " " " deformed, struct'l grade | 55-70 | 33 | tensile | tensile | ¾ tens. | 29000000 | 22.7-17.9 |
| " " " " intermediate | 70-85 | 40 | tensile | tensile | ¾ tens. | 29000000 | 16.1-13.2 |
| " " " " hard | 80 | 50 | tensile | tensile | ¾ tens. | 29000000 | 12.5 |
| " " " cold twisted | ..... | 55 | tensile | tensile | ¾ tens. | 29000000 | 5 0 |
| " rivets*, boilers | 45-55 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 33.3-27.3 |
| " " bridges | 46-56 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 32 6-26 8 |
| " " buildings | 46-56 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 30.4-25 0 |
| " " cars | 48 58 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 31.3-25.9 |
| " " ships | 55-65 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 27.3-23.0 |

# STRENGTH OF MATERIALS

## STRESS IN KIPS PER SQUARE INCH

| Metals and Alloys | Tension, Ultimate | Elastic Limit | Compression, Ultimate | Bending, Ultimate | Shearing, Ultimate | Modulus of Elasticity, Pounds | Elongation, % |
|---|---|---|---|---|---|---|---|
| Steel Shapes, bridges | 55–65 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 27.3–23.0 |
| " " buildings | 55–65 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 25.4–21.5 |
| " " cars | 50–65 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 30.0–23.0 |
| " " locomotives | 55–65 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 27.3–23.0 |
| " " ships | 58–68 | ½ tens. | tensile | tensile | ¾ tens. | 29000000 | 25.9–22.1 |
| Steel Alloys, Nickel Steel,* 3.25% N. | | | | | | | |
| " " " shapes, plates, bars | 85–100 | 50 | tensile | tensile | ¾ tens. | 29000000 | 17.6–15.0 |
| " " " rivets | 70–80 | 45 | tensile | tensile | ¾ tens. | 29000000 | 21.4–18.8 |
| " " " eye bars, unannealed | 95–110 | 55 | tensile | tensile | ¾ tens. | 29000000 | 15.8–13.6 |
| " " " " " annealed | 90–105 | 52 | tensile | tensile | ¾ tens. | 29000000 | 20.0 |
| " " Copper Steel, 0.50% Cu | 60–68 | 37–38 | tensile | tensile | ¾ tens. | 29000000 | 29.0–23.0 |
| Steel Springs, untempered | 65–110 | 40–70 | ..... | ..... | ..... | ..... | ..... |
| Steel Wire, unannealed | 120 | 60 | ..... | ..... | ..... | ..... | ..... |
| " " annealed | 80 | 40 | ..... | ..... | ..... | ..... | ..... |
| " " bridge cable | 200 | 95 | ..... | ..... | ..... | ..... | ..... |
| Tin, cast | 3.5–4.6 | 1.5–1.8 | 6 | 4 | ..... | 4000000 | ..... |
| " antimony, 10 Sn, 1 Sb | 11 | ..... | ..... | ..... | ..... | ..... | ..... |
| Zinc, cast | 4–6 | 4 | 18 | 7 | ..... | 13000000 | ..... |
| " rolled sheets | 7–16 | ..... | ..... | ..... | ..... | ..... | ..... |

## STRESS IN POUNDS PER SQUARE INCH

| Building Materials | Ultimate Average Stress | | | Modulus of Elasticity | Safe Working Stress | | |
|---|---|---|---|---|---|---|---|
| | Compress | Tension | Bending | | Compress. | Bearing | Shearing |
| Brick, Common, good | 10000 | 200 | 600 | ..... | ..... | ..... | ..... |
| " " medium burned | 11000 | ..... | ..... | ..... | ..... | ..... | ..... |
| " " hard burned | 15000 | ..... | ..... | ..... | ..... | ..... | ..... |
| " Pressed and paving | 6000 | ..... | ..... | ..... | ..... | ..... | ..... |
| Concrete. ** | | | | | | | |
| Masonry, Granite | ..... | ..... | ..... | ..... | 420 | 600 | ..... |
| " Limestone, bluestone | ..... | ..... | ..... | ..... | 350 | 500 | ..... |
| " Sandstone | ..... | ..... | ..... | ..... | 280 | 400 | ..... |
| " Rubble | ..... | ..... | ..... | ..... | 140 | 250 | ..... |
| " " coursed | ..... | ..... | ..... | ..... | 168 | 250 | ..... |
| " Brick, common | ..... | ..... | ..... | ..... | 168 | 300 | ..... |
| " " hard burned | ..... | ..... | ..... | ..... | 210 | 300 | ..... |
| Stone, Bluestone | 12000 | 1200 | 2500 | 7000000 | 1200 | 1200 | 200 |
| " Granite, gneiss | 12000 | 1200 | 1600 | 7000000 | 1200 | 1200 | 200 |
| " Limestone, marble | 8000 | 800 | 1500 | 7000000 | 800 | 800 | 150 |
| " Sandstone | 5000 | 150 | 1200 | 3000000 | 500 | 500 | 150 |
| " Slate | 10000 | 3000 | 5000 | 14000000 | 1000 | 1000 | 175 |
| Miscellaneous, Glass, common | 30000 | 3000 | 3000 | 8000000 | ..... | ..... | ..... |
| " " flooring | 10000 | 3000 | 3000 | ..... | ..... | ..... | ..... |
| " Plaster | 700 | 70 | ..... | ..... | ..... | ..... | ..... |
| " Terra cotta | 5000 | ..... | ..... | ..... | ..... | ..... | ..... |
| " Ropes, cast steel hoisting | ..... | 80000 | ..... | ..... | ..... | ..... | ..... |
| " " standing, derrick | ..... | 70000 | ..... | ..... | ..... | ..... | ..... |
| " " manila | ..... | 8000 | ..... | ..... | ..... | ..... | ..... |
| " Belts, solid woven, cotton | ..... | 7300 | ..... | ..... | ..... | ..... | ..... |
| " " " " flax | ..... | 9900 | ..... | ..... | ..... | ..... | ..... |

*See Specifications of the American Society for Testing Materials.

**Extensive laboratory tests recently conducted, indicate that the water cement ratio in concrete mixtures has a very important influence on the ultimate strength of the finished product. Data on this subject can be obtained from the Portland Cement Association, Chicago.

# SPECIFIC GRAVITIES AND WEIGHTS

| Substance | Specific Gravity | Weight, Pounds per Cu. Ft. |
|---|---|---|
| **Metals, Alloys, Ores** | | |
| Aluminum, cast-hammered | 2.55–2.75 | 165 |
| Aluminum, bronze | 7.7 | 481 |
| Brass, cast-rolled | 8.4–8.7 | 534 |
| Bronze, 7.9 to 14% Sn | 7.4–8.9 | 509 |
| Copper, cast-rolled | 8 8–9.0 | 556 |
| Copper ore, pyrites | 4.1–4.3 | 262 |
| Gold, cast-hammered | 19.25–19.3 | 1205 |
| Iron, cast, pig | 7.2 | 450 |
| Iron, wrought | 7.6–7.9 | 485 |
| Iron, steel | 7.8–7.9 | 490 |
| Iron, spiegel-eisen | 7.5 | 468 |
| Iron, ferro-silicon | 6.7–7 3 | 437 |
| Iron ore, hematite | 5.2 | 325 |
| Iron ore, hematite in bank | .... | 160-180 |
| Iron ore, hematite loose | ..... | 130-160 |
| Iron ore, limonite | 3.6–4.0 | 237 |
| Iron ore, magnetite | 4.9–5.2 | 315 |
| Iron slag | 2.5–3.0 | 172 |
| Lead | 11.37 | 710 |
| Lead ore, galena | 7.3–7.6 | 465 |
| Manganese | 7.2–8.0 | 475 |
| Manganese ore, pyrolusite | 3.7–4.6 | 259 |
| Mercury | 13.6 | 849 |
| Nickel | 8.9–9.2 | 565 |
| Nickel, monel metal | 8.8–9.0 | 556 |
| Platinum, cast-hammered | 21.1–21.5 | 1330 |
| Silver, cast-hammered | 10.4–10.6 | 656 |
| Tin, cast-hammered | 7.2–7.5 | 459 |
| Tin ore, cassiterite | 6.4–7.0 | 418 |
| Zinc, cast-rolled | 6.9–7.2 | 440 |
| Zinc ore, blende | 3.9–4.2 | 253 |
| **Various Solids** | | |
| Cereals, oats, bulk | | 32 |
| Cereals, barley, bulk | | 39 |
| Cereals, corn, rye, bulk | | 48 |
| Cereals, wheat, bulk | | 48 |
| Hay and Straw, bales | | 20 |
| Cotton, Flax, Hemp | 1.47–1.50 | 93 |
| Fats | 0.90–0 97 | 58 |
| Flour, loose | 0.40–0.50 | 28 |
| Flour, pressed | 0.70–0.80 | 47 |
| Glass, common | 2.40–2.60 | 156 |
| Glass, plate or crown | 2.45–2.72 | 161 |
| Glass, crystal | 2.90–3.00 | 184 |
| Leather | 0.86–1 02 | 59 |
| Paper | 0.70–1.15 | 58 |
| Potatoes, piled | .... | 42 |
| Rubber, caoutchouc | 0.92–0 96 | 59 |
| Rubber goods | 1.0–2.0 | 94 |
| Salt, granulated, piled | ..... | 48 |
| Saltpeter | ..... | 67 |
| Starch | 1.53 | 96 |
| Sulphur | 1.93–2.07 | 125 |
| Wool | 1.32 | 82 |

| Substance | Specific Gravity | Weight, Pounds per Cu. Ft. |
|---|---|---|
| **Timber, U. S. Seasoned** | | |
| Ash, white-red | 0.62–0.65 | 40 |
| Cedar, white-red | 0.32–0.38 | 22 |
| Chestnut | 0.66 | 41 |
| Cypress | 0.48 | 30 |
| Fir, Douglas spruce | 0.51 | 32 |
| Fir, eastern | 0.40 | 25 |
| Elm, white | 0.72 | 45 |
| Hemlock | 0 42–0.52 | 29 |
| Hickory | 0.74–0.84 | 49 |
| Locust | 0.73 | 46 |
| Maple, hard | 0.68 | 43 |
| Maple, white | 0 53 | 33 |
| Oak, chestnut | 0 86 | 54 |
| Oak, live | 0.95 | 59 |
| Oak, red, black | 0.65 | 41 |
| Oak, white | 0 74 | 46 |
| Pine, Oregon | 0.51 | 32 |
| Pine, red | 0.48 | 30 |
| Pine, white | 0.41 | 26 |
| Pine, yellow, long-leaf | 0.70 | 44 |
| Pine, yellow, short-leaf | 0.61 | 38 |
| Poplar | 0.48 | 30 |
| Redwood, California | 0.42 | 26 |
| Spruce, white, black | 0.40–0.46 | 27 |
| Walnut, black | 0.61 | 38 |
| Walnut, white | 0.41 | 26 |
| Moisture Contents: | | |
| Seasoned timber 15 to 20% | | |
| Green timber up to 50% | | |
| **Various Liquids** | | |
| Alcohol, 100% | 0.79 | 49 |
| Acids, muriatic 40% | 1.20 | 75 |
| Acids, nitric 91% | 1.50 | 94 |
| Acids, sulphuric 87% | 1.80 | 112 |
| Lye, soda 66% | 1.70 | 106 |
| Oils, vegetable | 0.91–0.94 | 58 |
| Oils, mineral, lubricants | 0.90–0.93 | 57 |
| Water, 4°C, max. density | 1.0 | 62.428 |
| Water, 100°C | 0.9584 | 59.830 |
| Water, ice | 0.88 0.92 | 56 |
| Water, snow, fresh fallen | .125 | 8 |
| Water, sea water | 1.02–1.03 | 64 |
| **Gases, Air = 1** | | |
| Air, 0°C, 760 mm | 1 0 | .08071 |
| Ammonia | 0.5920 | .0478 |
| Carbon dioxide | 1.5291 | .1234 |
| Carbon monoxide | 0.9673 | .0781 |
| Gas, illuminating | 0.35–0.45 | .028–.036 |
| Gas, natural | 0.47–0.48 | .038–.039 |
| Hydrogen | 0.0693 | .00559 |
| Nitrogen | 0.9714 | .0784 |
| Oxygen | 1.1056 | .0892 |

The specific gravities of solids and liquids refer to water at 4°C., those of gases to air at 0°C. and 760 mm pressure. The weights per cubic foot are derived from average specific gravities, except where stated that weights are for bulk, heaped or loose material, etc.

# SPECIFIC GRAVITIES AND WEIGHTS

| Substance | Specific Gravity | Weight, Pounds per Cu. Ft. |
|---|---|---|
| **Ashlar Masonry** | | |
| Granite, syenite, gneiss | 2.3–3.0 | 165 |
| Limestone, marble | 2.3–2.8 | 160 |
| Sandstone, bluestone | 2.1–2.4 | 140 |
| **Mortar Rubble Masonry** | | |
| Granite, syenite, gneiss | 2.2–2.8 | 155 |
| Limestone, marble | 2.2–2.6 | 150 |
| Sandstone, bluestone | 2.0–2.2 | 130 |
| **Dry Rubble Masonry** | | |
| Granite, syenite, gneiss | 1.9–2.3 | 130 |
| Limestone, marble | 1.9–2.1 | 125 |
| Sandstone, bluestone | 1.8–1.9 | 110 |
| **Brick Masonry** | | |
| Pressed brick | 2.2–2.3 | 140 |
| Common brick | 1.8–2.0 | 120 |
| Soft brick | 1.5–1.7 | 100 |
| **Concrete Masonry** | | |
| Cement, stone, sand | 2.2–2.4 | 144 |
| Cement, slag, etc | 1.9–2.3 | 130 |
| Cement, cinder, etc | 1.5–1.7 | 100 |
| **Various Building Mat'l** | | |
| Ashes, cinders | | 40–45 |
| Cement, portland, loose | | 90 |
| Cement, portland, set | 2.7–3.2 | 183 |
| Lime, gypsum, loose | | 53–64 |
| Mortar, set | 1.4–1.9 | 103 |
| Slags, bank slag | | 67–72 |
| Slags, bank screenings | | 98–117 |
| Slags, machine slag | | 96 |
| Slags, slag sand | | 49–55 |
| **Earth, etc., Excavated** | | |
| Clay, dry | | 63 |
| Clay, damp, plastic | | 110 |
| Clay and gravel, dry | | 100 |
| Earth, dry, loose | | 76 |
| Earth, dry, packed | | 95 |
| Earth, moist, loose | | 78 |
| Earth, moist, packed | | 96 |
| Earth, mud, flowing | | 108 |
| Earth, mud, packed | | 115 |
| Riprap, limestone | | 80–85 |
| Riprap, sandstone | | 90 |
| Riprap, shale | | 105 |
| Sand, gravel, dry, loose | | 90–105 |
| Sand, gravel, dry, packed | | 100–120 |
| Sand, gravel, dry, wet | | 118–120 |
| **Excavations in Water** | | |
| Sand or gravel | | 60 |
| Sand or gravel and clay | | 65 |
| Clay | | 80 |
| River mud | | 90 |
| Soil | | 70 |
| Stone riprap | | 65 |

| Substance | Specific Gravity | Weight, Pounds per Cu. Ft. |
|---|---|---|
| **Minerals** | | |
| Asbestos | 2.1–2.8 | 153 |
| Barytes | 4.50 | 281 |
| Basalt | 2.7–3.2 | 184 |
| Bauxite | 2.55 | 159 |
| Borax | 1.7–1.8 | 109 |
| Chalk | 1.8–2.6 | 137 |
| Clay, marl | 1.8–2.6 | 137 |
| Dolomite | 2.9 | 181 |
| Feldspar, orthoclase | 2.5–2.6 | 159 |
| Gneiss, serpentine | 2.4–2.7 | 159 |
| Granite, syenite | 2.5–3.1 | 175 |
| Greenstone, trap | 2.8–3.2 | 187 |
| Gypsum, alabaster | 2.3–2.8 | 159 |
| Hornblende | 3.0 | 187 |
| Limestone, marble | 2.5–2.8 | 165 |
| Magnesite | 3.0 | 187 |
| Phosphate rock, apatite | 3.2 | 200 |
| Porphyry | 2.6–2.9 | 172 |
| Pumice, natural | 0.37–0.90 | 40 |
| Quartz, flint | 2.5–2.8 | 165 |
| Sandstone, bluestone | 2.2–2.5 | 147 |
| Shale, slate | 2.7–2.9 | 175 |
| Soapstone, talc | 2.6–2.8 | 169 |
| **Stone, Quarried, Piled** | | |
| Basalt, granite, gneiss | | 96 |
| Limestone, marble, quartz | | 95 |
| Sandstone | | 82 |
| Shale | | 92 |
| Greenstone, hornblende | | 107 |
| **Bituminous Substances** | | |
| Asphaltum | 1.1–1.5 | 81 |
| Coal, anthracite | 1.4–1.7 | 97 |
| Coal, bituminous | 1.2–1.5 | 84 |
| Coal, lignite | 1.1–1.4 | 78 |
| Coal, peat, turf, dry | 0.65–0.85 | 47 |
| Coal, charcoal, pine | 0.28–0.44 | 23 |
| Coal, charcoal, oak | 0.47–0.57 | 33 |
| Coal, coke | 1.0–1.4 | 75 |
| Graphite | 1.9–2.3 | 131 |
| Paraffine | 0.87–0.91 | 56 |
| Petroleum | 0.87 | 54 |
| Petroleum, refined | 0.79–0.82 | 50 |
| Petroleum, benzine | 0.73–0.75 | 46 |
| Petroleum, gasoline | 0.66–0.69 | 42 |
| Pitch | 1.07–1.15 | 69 |
| Tar, bituminous | 1.20 | 75 |
| **Coal and Coke, Piled** | | |
| Coal, anthracite | | 47–58 |
| Coal, bituminous, lignite | | 40–54 |
| Coal, peat, turf | | 20–26 |
| Coal, charcoal | | 10–14 |
| Coal, coke | | 23–32 |

The specific gravities of solids and liquids refer to water at 4°C., those of gases to air at 0°C. and 760 mm pressure. The weights per cubic foot are derived from average specific gravities, except where stated that weights are for bulk, heaped or loose material, etc.

# PROPERTIES OF AMERICAN STANDARD YARD LUMBER AND TIMBER SIZES

NATIONAL LUMBER MANUFACTURERS ASSOCIATION

| Nominal Size | American Standard Dressed Size | Area of Section A = bd | Weight per Lineal foot | Moment of Inertia $I = \frac{bd^3}{12}$ | Section Modulus $S = \frac{bd^2}{6}$ |
|---|---|---|---|---|---|
| Inches | Inches | Sq. In. | Pounds | | |
| 2× 4 | 1⅝× 3⅝ | 5.89 | 1.6 | 6.45 | 3.56 |
| 2× 6 | 1⅝× 5⅝ | 9.14 | 2.5 | 24.10 | 8.57 |
| 2× 8 | 1⅝× 7½ | 12.19 | 3.4 | 57.13 | 15.32 |
| 2×10 | 1⅝× 9½ | 15.44 | 4.3 | 116.09 | 24.44 |
| 2×12 | 1⅝×11½ | 18.69 | 5.2 | 205.94 | 35.82 |
| 2×14 | 1⅝×13½ | 23.62 | 6.5 | 333.15 | 49.36 |
| 2×16 | 1⅝×15½ | 25.18 | 7.0 | 504.24 | 65.07 |
| 2×18 | 1⅝×17½ | 28 43 | 7.9 | 725.71 | 82.94 |
| 2×20 | 1⅝×19½ | 31.69 | 8.8 | 1004.05 | 102.98 |
| 3× 4 | 2⅝× 3⅝ | 9.51 | 2.6 | 10.42 | 5.75 |
| 3× 6 | 2⅝× 5⅝ | 14.76 | 4.2 | 38.93 | 13.84 |
| 3× 8 | 2⅝× 7½ | 19.68 | 5.7 | 92.28 | 24 60 |
| 3×10 | 2⅝× 9½ | 24.93 | 7.2 | 187.55 | 39.48 |
| 3×12 | 2⅝×11½ | 30.18 | 8.8 | 332.69 | 57 86 |
| 3×14 | 2⅝×13½ | 35.43 | 10.3 | 538.21 | 79.73 |
| 3×16 | 2⅝×15½ | 40.68 | 11.3 | 814.60 | 105 11 |
| 3×18 | 2⅝×17½ | 45.94 | 12.8 | 1172.36 | 133.98 |
| 3×20 | 2⅝×19½ | 51.19 | 14.2 | 1622.00 | 166.36 |
| 4× 4 | 3⅝× 3⅝ | 13.14 | 3.6 | 14.38 | 7.94 |
| 4× 6 | 3⅝× 5⅝ | 20.39 | 5.7 | 53.76 | 19.11 |
| 4× 8 | 3⅝× 7½ | 27.18 | 7.5 | 127.44 | 33.98 |
| 4×10 | 3⅝× 9½ | 34.43 | 9.6 | 258.99 | 54.52 |
| 4×12 | 3⅝×11½ | 41.68 | 11.6 | 459 42 | 79.90 |
| 4×14 | 3⅝×13½ | 48.93 | 13.6 | 743.23 | 110.11 |
| 4×16 | 3⅝×15½ | 56.18 | 15.6 | 1124.90 | 145.15 |
| 4×18 | 3⅝×17½ | 63.43 | 17.6 | 1618 96 | 185.02 |
| 4×20 | 3⅝×19½ | 70.69 | 19.6 | 2239.88 | 229.73 |
| 6× 6 | 5½× 5½ | 30.25 | 8.4 | 76 25 | 27.73 |
| 6× 8 | 5½× 7½ | 41.25 | 11 4 | 193 35 | 51 56 |
| 6×10 | 5½× 9½ | 52.25 | 14 5 | 329 96 | 82 73 |
| 6×12 | 5½×11½ | 63.25 | 17 5 | 697.06 | 121 23 |
| 6×14 | 5½×13½ | 74 25 | 20 6 | 1127 66 | 167 06 |
| 6×16 | 5½×15½ | 85 25 | 23 6 | 1706 76 | 220 22 |
| 6×18 | 5½×17½ | 96 25 | 26.7 | 2456.36 | 280.73 |
| 6×20 | 5½×19½ | 107 25 | 29.8 | 3398.46 | 348 56 |
| 6×22 | 5½×21½ | 118.25 | 32.8 | 4555.05 | 423.73 |
| 8× 8 | 7½× 7½ | 56.25 | 15.6 | 263.67 | 70.31 |
| 8×10 | 7½× 9½ | 71.25 | 19.8 | 535.85 | 112.81 |
| 8×12 | 7½×11½ | 86.25 | 23.9 | 950.55 | 165.31 |
| 8×14 | 7½×13½ | 101.25 | 28.0 | 1537.73 | 227.81 |
| 8×16 | 7½×15½ | 116.25 | 32.0 | 2327.42 | 300.31 |
| 8×18 | 7½×17½ | 131.25 | 36.4 | 3349 60 | 382 81 |
| 8×20 | 7½×19½ | 146.25 | 40.6 | 4634.30 | 475.31 |
| 8×22 | 7½×21½ | 161.25 | 44.8 | 6211.48 | 577.81 |
| 8×24 | 7½×23½ | 176.25 | 48.9 | 8111.17 | 690.31 |
| 10×10 | 9½× 9½ | 90.25 | 25.0 | 678.75 | 142.89 |
| 10×12 | 9½×11½ | 109.25 | 30.3 | 1204.01 | 209.39 |
| 10×14 | 9½×13½ | 128.25 | 35.6 | 1947.78 | 288.56 |
| 10×16 | 9½×15½ | 147.25 | 40.9 | 2948.04 | 380.39 |
| 10×18 | 9½×17½ | 166.25 | 46.1 | 4242.80 | 484.89 |
| 10×20 | 9½×19½ | 185.25 | 51.4 | 5870.05 | 602.06 |
| 10×22 | 9½×21½ | 204.25 | 56.7 | 7867.81 | 731.89 |
| 10×24 | 9½×23½ | 223 25 | 62.0 | 10274.06 | 874.39 |
| 10×26 | 9½×25½ | 242.25 | 67.3 | 13126.81 | 1029.56 |
| 10×28 | 9½×27½ | 261.25 | 72.5 | 16465.24 | 1197.39 |
| 10×30 | 9½×29½ | 280.25 | 77.8 | 20323.79 | 1377.89 |
| 12×12 | 11½×11½ | 132.25 | 36.7 | 1457.50 | 253.47 |
| 12×14 | 11½×13½ | 155.25 | 43.1 | 2357 85 | 349.31 |
| 12×16 | 11½×15½ | 178.25 | 49.5 | 3568.70 | 460.48 |
| 12×18 | 11½×17½ | 201.25 | 55.9 | 5136.49 | 586.98 |
| 12×20 | 11½×19½ | 224.25 | 62.3 | 7105.90 | 728.81 |
| 12×22 | 11½×21½ | 247.25 | 68.7 | 9524.24 | 885.98 |
| 12×24 | 11½×23½ | 270 25 | 75.0 | 12437 08 | 1058.47 |
| 12×26 | 11½×25½ | 293.25 | 81.4 | 15890.42 | 1246.31 |
| 12×28 | 11½×27½ | 316.25 | 87 8 | 19932.58 | 1449.47 |
| 12×30 | 11½×29½ | 339.25 | 94.2 | 24602.61 | 1667.97 |
| 14×14 | 13½×13½ | 182 25 | 50.6 | 2767.92 | 410.06 |
| 14×16 | 13½×15½ | 209 25 | 58.1 | 4189.36 | 540.56 |
| 14×18 | 13½×17½ | 236.25 | 65.6 | 6029.29 | 689.06 |
| 14×20 | 13½×19½ | 263.25 | 73.1 | 8341 73 | 855.56 |
| 14×22 | 13½×21½ | 290.25 | 80.6 | 11180.67 | 1040.06 |
| 14×24 | 13½×23½ | 317.25 | 88.1 | 14600.10 | 1242.56 |
| 14×26 | 13½×25½ | 344.25 | 95.6 | 18654.04 | 1463.06 |
| 14×28 | 13½×27½ | 371.25 | 103.1 | 23398 73 | 1701.56 |
| 14×30 | 13½×29½ | 398.25 | 110.6 | 28881.42 | 1958.06 |
| 16×16 | 15½×15½ | 240.25 | 66.7 | 4809 98 | 620.64 |
| 16×18 | 15½×17½ | 271 25 | 75 3 | 6922.49 | 791 14 |
| 16×20 | 15½×19½ | 302 25 | 83.9 | 9577.50 | 982.31 |
| 16×22 | 15½×21½ | 333.25 | 92.5 | 12837.00 | 1194.14 |
| 16×24 | 15½×23½ | 364.25 | 101.2 | 16763.00 | 1426.64 |
| 16×26 | 15½×25½ | 395.25 | 109 8 | 21417.50 | 1679.81 |
| 16×28 | 15½×27½ | 426.25 | 118 4 | 26863.78 | 1953.64 |
| 16×30 | 15½×29½ | 457.25 | 127.0 | 33159.98 | 2248.14 |
| 18×18 | 17½×17½ | 306.25 | 85.0 | 7815 73 | 893.23 |
| 18×20 | 17½×19½ | 341.25 | 94.8 | 10813.33 | 1109.06 |
| 18×22 | 17½×21½ | 376.25 | 104.5 | 14493 43 | 1348.23 |
| 18×24 | 17½×23½ | 411.25 | 114.2 | 18926.02 | 1610.72 |
| 18×26 | 17½×25½ | 446.25 | 123.9 | 24181.11 | 1896.56 |
| 18×28 | 17½×27½ | 481.25 | 133.7 | 30331.62 | 2205.72 |
| 18×30 | 17½×29½ | 516.25 | 143.4 | 37438.79 | 2538.22 |
| 20×20 | 19½×19½ | 380.25 | 105 6 | 12049.49 | 1235.81 |
| 20×22 | 19½×21½ | 419.25 | 116.4 | 16149.86 | 1502.31 |
| 20×24 | 19½×23½ | 458.25 | 127.3 | 21089.04 | 1794.81 |
| 20×26 | 19½×25½ | 497.25 | 138.1 | 26944.73 | 2113.31 |
| 20×28 | 19½×27½ | 536.25 | 148.9 | 33798.17 | 2457.81 |
| 20×30 | 19½×29½ | 575.25 | 159.8 | 41717.61 | 2828.31 |
| 24×24 | 23½×23½ | 552.25 | 153.4 | 25414.96 | 2162.97 |
| 24×26 | 23½×25½ | 599.25 | 166.4 | 32471.80 | 2546.81 |
| 24×28 | 23½×27½ | 646.25 | 179.5 | 40731.06 | 2916.97 |
| 24×30 | 23½×29½ | 693.25 | 192.5 | 50274.98 | 3408.47 |

The weights given above are based on assumed average weight of 40 lbs. per cubic foot.

# SAFE LOAD IN POUNDS PER SQUARE INCH OF CROSS-SECTIONAL AREA

## SQUARE AND RECTANGULAR TIMBER COLUMNS

DRY LOCATIONS

| Species of Lumber | American Standard Grade | *Ratio of Length to Least Dimension ($l/d$) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10& less | $l/d$ 12 | $l/d$ 14 | $l/d$ 16 | $l/d$ 18 | $l/d$ 20 | $l/d$ 25 | $l/d$ 30 | $l/d$ 35 | $l/d$ 40 | $l/d$ 50 |
| | | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. |
| Ash, Commercial White | Select | 1100 | 1076 | 1055 | 1023 | 978 | 913 | 658 | 457 | 336 | 257 | 164 |
| | Common | 880 | 868 | 857 | 840 | 818 | 784 | 647 | | | | |
| Cedar, Western Red; Fir, Balsam | Select | 700 | 686 | 674 | 656 | 629 | 592 | 438 | 304 | 224 | 171 | 110 |
| | Common | 560 | 553 | 547 | 538 | 524 | 505 | 425 | | | | |
| Cedar, Northern and Southern White | Select | 550 | 540 | 530 | 516 | 496 | 468 | 351 | 244 | 179 | 137 | 88 |
| | Common | 440 | 435 | 430 | 423 | 412 | 398 | 338 | | | | |
| Chestnut; Pine, Northern White, Idaho White, Sugar, Calif. White, and Pondosa | Select | 750 | 733 | 718 | 695 | 663 | 617 | 438 | 304 | 224 | 171 | 110 |
| | Common | 600 | 591 | 583 | 572 | 556 | 532 | 434 | | | | |
| Cypress, Southern; Larch, Western | Select | 1100 | 1063 | 1030 | 981 | 909 | 810 | 526 | 365 | 268 | 206 | 132 |
| | Common | 880 | 861 | 843 | 818 | 781 | 729 | | | | | |
| Douglas Fir (Coast Region); Pine, Southern Yellow; Beech; Birch, Yellow and Sweet; Maple, Sugar | **Dense Select | 1285 | 1251 | 1222 | 1176 | 1112 | 1022 | 702 | 487 | 358 | 274 | 175 |
| | Select | 1175 | 1149 | 1127 | 1093 | 1045 | 975 | 702 | | | | |
| | Common | 880 | 870 | 861 | 847 | 826 | 796 | 675 | | | | |
| Douglas Fir (Rky. Mtn. Region); Spruce, Red, White, Sitka; Norway Pine; Alaska Cedar; Elm, Slippery and White; Sycamore; Gum, Red and Black; Tupelo | Select | 800 | 786 | 774 | 753 | 726 | 688 | 526 | 365 | 268 | 206 | 132 |
| | Common | 640 | 632 | 627 | 617 | 602 | 582 | 500 | | | | |
| Hemlock, West Coast | Select | 900 | 885 | 872 | 852 | 823 | 783 | 614 | 426 | 313 | 240 | 153 |
| | Common | 720 | 712 | 706 | 696 | 680 | 660 | 573 | | | | |
| Hemlock, Eastern; Fir, Commercial White | Select | 700 | 689 | 678 | 664 | 641 | 611 | 482 | 335 | 246 | 188 | 121 |
| | Common | 560 | 554 | 549 | 542 | 530 | 515 | 449 | | | | |
| Oak, White and Red | Select | 1000 | 982 | 967 | 943 | 908 | 860 | 658 | 457 | 336 | 257 | 164 |
| | Common | 800 | 790 | 783 | 771 | 753 | 728 | 625 | | | | |
| Redwood | Select | 1000 | 972 | 947 | 910 | 856 | 781 | 526 | 365 | 268 | 206 | 132 |
| | Common | 800 | 786 | 773 | 754 | 726 | 688 | | | | | |
| Spruce, Englemann | Select | 600 | 586 | 574 | 556 | 530 | 494 | 351 | 244 | 179 | 137 | 88 |
| | Common | 480 | 473 | 466 | 457 | 444 | 426 | 347 | | | | |
| Tamarack | Select | 1000 | 976 | 955 | 923 | 877 | 817 | 570 | 396 | 291 | 223 | 142 |
| | Common | 800 | 788 | 777 | 761 | 737 | 706 | 566 | | | | |

SAFE LOADS in compression parallel to grain for timber columns shall not exceed in pounds per square inch the values given in the above table for the respective species, grade, and ratio of unsupported length to least dimension, ($l/d$).

No column shall be used in which the unsupported length is more than 50 times the least diameter. $l$ and $d$ must be figured in the same unit of measurement.

# ALLOWABLE UNIT STRESSES FOR STRUCTURAL LUMBER AND TIMBER

ALL SIZES, DRY LOCATIONS

| Species of Timber | American Standard Grade | Allowable Unit Stress in Pounds per Square Inch | | | | |
|---|---|---|---|---|---|---|
| | | Bending Stress | | Compression Stress | | Modulus of Elasticity (All Locations) |
| | | In Extreme Fibre | Horizontal Shear All Locations | Parallel to Grain | Perpendicular to Grain | |
| Cedar, Western Red | Select<br>Common | 900<br>720 | 80<br>64 | 700<br>560 | 200 | 1000000 |
| Cedar, Northern and Southern White | Select<br>Common | 750<br>600 | 70<br>56 | 550<br>440 | 175 | 800000 |
| Cedar, Port Orford | Select<br>Common | 1100<br>880 | 90<br>72 | 900<br>720 | 250 | 1200000 |
| Cedar, Alaska | Select<br>Common | 1100<br>880 | 90<br>72 | 800<br>640 | 250 | 1200000 |
| Cypress, Southern | Select<br>Common | 1300<br>1040 | 100<br>80 | 1100<br>880 | 350 | 1200000 |
| Douglas Fir, Coast Region (Western Washington and Oregon) | Dense Select<br>Select<br>Common | 1750<br>1600<br>1200 | 105<br>90<br>72 | 1285<br>1175<br>880 | 380<br>345<br>325 | 1600000 |
| Douglas Fir, Rocky Mountain Region | Select<br>Common | 1100<br>880 | 85<br>68 | 800<br>640 | 275 | 1200000 |
| Fir, Balsam | Select<br>Common | 900<br>720 | 70<br>56 | 700<br>560 | 150 | 1000000 |
| Fir, Golden, Noble, Silver, White (Commercial White) | Select<br>Common | 1100<br>880 | 70<br>56 | 700<br>560 | 300 | 1100000 |
| Hemlock, West Coast | Select<br>Common | 1300<br>1040 | 75<br>60 | 900<br>720 | 300 | 1400000 |
| Hemlock, Eastern | Select<br>Common | 1100<br>880 | 70<br>56 | 700<br>560 | 300 | 1100000 |
| Larch, Western | Select<br>Common | 1200<br>960 | 100<br>80 | 1100<br>880 | 325 | 1300000 |
| Oak, Commercial White and Red | Select<br>Common | 1400<br>1120 | 125<br>100 | 1000<br>800 | 500 | 1500000 |
| Pine, Southern Yellow | Dense Select<br>Select<br>Common | 1750<br>1600<br>1200 | 128<br>110<br>88 | 1285<br>1175<br>880 | 380<br>345<br>325 | 1600000 |
| Pine, Calif., Idaho and No. White, Lodgepole, Pondosa, Sugar, Westn. Yellow | Select<br>Common | 900<br>720 | 85<br>68 | 750<br>600 | 250 | 1000000 |
| Pine, Norway | Select<br>Common | 1100<br>880 | 85<br>68 | 800<br>640 | 300 | 1200000 |
| Redwood | Select<br>Common | 1200<br>960 | 70<br>56 | 1000<br>800 | 250 | 1200000 |
| Spruce, Red, White, Sitka | Select<br>Common | 1100<br>880 | 85<br>68 | 800<br>640 | 250 | 1200000 |
| Spruce, Englemann | Select<br>Common | 750<br>600 | 70<br>56 | 600<br>480 | 175 | 800000 |
| Tamarack, Eastern | Select<br>Common | 1200<br>960 | 95<br>76 | 1000<br>800 | 300 | 1300000 |

The allowable working stresses given above are taken from recommendations of the Forest Products Laboratory of the Department of Agriculture at Madison, Wisconsin, for use in dry locations. The grades for which stresses are given are for dimension lumber and timber equivalent in quality to the American Standards for Structural Material as published by the Bureau of Standards, U. S. Department of Commerce, in Simplified Practice Recommendation No. 16.

These grades and stresses have been adopted by the American Railway Engineering Association, accepted by the American Society for Testing Materials, and are recommended by the Building Code Committee of the Department of Commerce.

All computations to determine the required size of lumber members should be based on the net cross sectional area or actual size.

# ALLOWABLE UNIT STRESSES FOR STRUCTURAL LUMBER AND TIMBER

## USED IN LOCATIONS USUALLY WET

| Species | Grade | Allowable Unit Stress in Pounds per Square Inch | | | | | |
|---|---|---|---|---|---|---|---|
| | | Bending Stress | | | Compression Stress | | Modulus of Elasticity |
| | | In Extreme Fibre | | Horizontal Shear | Parallel to Grain | Perpendicular to Grain | |
| | | Joist and Plank Sizes 4" and less in thickness | Beam and Stringer Sizes 5" & thicker | | | | |
| Cedar, Western Red | Select<br>Common | 670<br>570 | 750<br>600 | 80<br>64 | 650<br>520 | 125 | 1000000 |
| Cedar, Northern & Southern White | Select<br>Common | 530<br>450 | ....<br>.... | 70<br>56 | ...<br>... | 100 | 800000 |
| Cedar, Port Orford | Select<br>Common | 800<br>680 | 900<br>720 | 90<br>72 | 750<br>600 | 150 | 1200000 |
| Cedar, Alaska | Select<br>Common | 800<br>680 | ...<br>.. | 90<br>72 | .<br>... | 150 | 1200000 |
| Cypress, Southern | Select<br>Common | 800<br>680 | ...<br>.. | 100<br>80 | ...<br>... | 225 | 1200000 |
| Douglas Fir, Coast Region (Western Washington and Oregon) | Dense Select<br>Select<br>Common | 1050<br>950<br>750 | 1165<br>1065<br>800 | 105<br>90<br>72 | 990<br>905<br>680 | 235<br>215<br>200 | 1600000 |
| Douglas Fir, Rocky Mountain Region | Select<br>Common | 620<br>530 | 700<br>560 | 85<br>68 | 700<br>560 | 200 | 1200000 |
| Fir, Balsam | Select<br>Common | 530<br>450 | ....<br>.... | 70<br>56 | ..<br>... | 100 | 1000000 |
| Fir, Golden, Noble, Silver, White (Commercial White) | Select<br>Common | 710<br>600 | ....<br>.... | 70<br>56 | ...<br>... | 200 | 1100000 |
| Hemlock, West Coast | Select<br>Common | 800<br>680 | 900<br>720 | 75<br>60 | 800<br>640 | 200 | 1400000 |
| Hemlock, Eastern | Select<br>Common | 710<br>600 | ...<br>.... | 70<br>56 | ..<br>.. | 200 | 1100000 |
| Larch, Western | Select<br>Common | 800<br>680 | 900<br>720 | 100<br>80 | 800<br>640 | 200 | 1300000 |
| Pine, Southern | Dense Select<br>Select<br>Common | 1050<br>950<br>750 | 1165<br>1065<br>800 | 128<br>110<br>88 | 990<br>905<br>680 | 235<br>215<br>200 | 1600000 |
| Pine, Calif., Idaho and No. White, Lodgepole, Pondosa and Sugar | Select<br>Common | 670<br>570 | ...<br>.... | 85<br>68 | ...<br>... | 125 | 1000000 |
| Pine, Norway | Select<br>Common | 710<br>600 | ....<br>.... | 85<br>68 | ...<br>... | 150 | 1200000 |
| Redwood | Select<br>Common | 710<br>600 | 800.<br>640 | 70<br>56 | 750<br>600 | 125 | 1200000 |
| Spruce, Red, White, Sitka | Select<br>Common | 710<br>600 | 800<br>640 | 85<br>68 | 650<br>520 | 125 | 1200000 |
| Spruce, Englemann | Select<br>Common | 440<br>370 | ...<br>.... | 70<br>56 | ..<br>... | 100 | 800000 |
| Tamarack, Eastern | Select<br>Common | 800<br>680 | ....<br>.... | 95<br>76 | ...<br>... | 200 | 1300000 |

The strength of wood is influenced largely by its moisture content, and therefore by the moisture conditions of service, which have an important bearing also on decay and checking. The allowable working stresses given above are taken from recommendations of the Forest Products Laboratory of the Department of Agriculture at Madison, Wisconsin, for use in locations where the lumber will be usually wet.

The grades for which stresses are given are for dimension lumber and timber equivalent in quality to the American Standards for Structural Material as published by the Bureau of Standards, U. S. Department of Commerce, in Simplified Practice Recommendation No. 16. These grades and stresses have been adopted by the American Railway Engineering Association, accepted by the American Society for Testing Materials, and are recommended by the Building Code Committee of the Department of Commerce.

All computations to determine the required size of lumber members should be based on the net cross sectional area or actual size.

# CONTENTS OF STORAGE WAREHOUSES

| Material | Weights per Cubic Foot of Space, Pounds | Height of Pile Feet | Weights per Square Foot of Floor Pounds | Recommended Live Loads, Pounds per Square Foot |
|---|---|---|---|---|
| **Building Materials** | | | | |
| Asbestos | 50 | 6 | 300 | |
| Bricks, Building | 45 | 6 | 270 | |
| Bricks, Fire Clay | 75 | 6 | 450 | |
| Cement, Natural | 59 | 6 | 354 | 300 |
| Cement, Portland | 73 | 6 | 438 | to |
| Gypsum | 50 | 6 | 300 | 400 |
| Lime and Plaster | 53 | 5 | 265 | |
| Tiles | 50 | 6 | 300 | |
| Woods, bulk | 45 | 6 | 270 | |
| **Drugs, Paints, Oil, Etc.** | | | | |
| Alum, Pearl, in barrels | 33 | 6 | 198 | |
| Bleaching Powder, in hogsheads | 31 | 3½ | 102 | |
| Blue Vitriol, in barrels | 45 | 5 | 226 | |
| Glycerine, in cases | 52 | 6 | 312 | |
| Linseed Oil, in barrels | 36 | 6 | 216 | |
| Linseed Oil, in iron drums | 45 | 4 | 180 | |
| Logwood Extract, in boxes | 70 | 5 | 350 | |
| Rosin, in barrels | 48 | 6 | 288 | 200 |
| Shellac, Gum | 38 | 6 | 228 | to |
| Soaps | 50 | 6 | 300 | 300 |
| Soda Ash, in hogsheads | 62 | 2¾ | 167 | |
| Soda, Caustic, in iron drums | 88 | 3⅜ | 294 | |
| Soda, Silicate, in barrels | 53 | 6 | 318 | |
| Sulphuric Acid | 60 | 1⅝ | 100 | |
| Toilet Articles | 35 | 6 | 210 | |
| Varnishes | 55 | 6 | 330 | |
| White Lead Paste, in cans | 174 | 3½ | 610 | |
| White, Lead, dry | 86 | 4¾ | 408 | |
| Red Lead and Litharge, dry | 132 | 3¾ | 495 | |
| **Dry Goods, Cotton, Wool, Etc.** | | | | |
| Burlap, in bales | 43 | 6 | 258 | |
| Carpets and Rugs | 30 | 6 | 180 | |
| Coir Yarn, in bales | 33 | 8 | 264 | |
| Cotton, in bales, American | 30 | 8 | 240 | |
| Cotton, in bales, Foreign | 40 | 8 | 320 | |
| Cotton Bleached Goods, in cases | 28 | 8 | 224 | |
| Cotton Flannel, in cases | 12 | 8 | 96 | |
| Cotton Sheeting, in cases | 23 | 8 | 184 | |
| Cotton Yarn, in cases | 25 | 8 | 200 | 200 |
| Excelsior, compressed | 19 | 8 | 152 | to |
| Hemp, Italian, compressed | 22 | 8 | 176 | 250 |
| Hemp, Manila, compressed | 30 | 8 | 240 | |
| Jute, compressed | 41 | 8 | 328 | |
| Linen Damask, in cases | 50 | 5 | 250 | |
| Linen Goods, in cases | 30 | 8 | 240 | |
| Linen Towels, in cases | 40 | 6 | 240 | |
| Silk and Silk Goods | 45 | 8 | 360 | |
| Sisal, compressed | 21 | 8 | 168 | |
| Tow, compressed | 29 | 8 | 232 | |
| Wool, in bales, compressed | 48 | | | |
| Wool, in bales, not compressed | 13 | 8 | 104 | |
| Wool, Worsteds, in cases | 27 | 8 | 216 | |

# CONTENTS OF STORAGE WAREHOUSES

| Material | Weights per Cubic Foot of Space, Pounds | Height of Pile Feet | Weights per Square Foot of Floor Pounds | Recommended Live Loads, Pounds per Square Foot |
|---|---|---|---|---|
| **Groceries, Wines, Liquors, Etc.** | | | | |
| Beans, in bags | 40 | 8 | 320 | |
| Beverages | 40 | 8 | 320 | |
| Canned Goods, in cases | 58 | 6 | 348 | |
| Cereals | 45 | 8 | 360 | |
| Cocoa | 35 | 8 | 280 | |
| Coffee, Roasted, in bags | 33 | 8 | 264 | |
| Coffee, Green, in bags | 39 | 8 | 312 | |
| Dates, in cases | 55 | 6 | 330 | |
| Figs, in cases | 74 | 5 | 370 | |
| Flour, in barrels | 40 | 5 | 200 | |
| Fruits, Fresh | 35 | 8 | 280 | 250 |
| Meat and Meat Products | 45 | 6 | 270 | to |
| Milk, Condensed | 50 | 6 | 300 | 300 |
| Molasses, in barrels | 48 | 5 | 240 | |
| Rice, in bags | 58 | 6 | 348 | |
| Sal Soda, in barrels | 46 | 5 | 230 | |
| Salt, in bags | 70 | 5 | 350 | |
| Soap Powder, in cases | 38 | 8 | 304 | |
| Starch, in barrels | 25 | 6 | 150 | |
| Sugar, in barrels | 43 | 5 | 215 | |
| Sugar, in cases | 51 | 6 | 306 | |
| Tea, in chests | 25 | 8 | 200 | |
| Wines and Liquors, in barrels | 38 | 6 | 228 | |
| **Hardware, Etc.** | | | | |
| Automobile Parts | 40 | 8 | 320 | |
| Chain | 100 | 6 | 600 | |
| Cutlery | 45 | 8 | 360 | |
| Door Checks | 45 | 6 | 270 | |
| Electrical Goods and Machinery | 40 | 8 | 320 | |
| Hinges | 64 | 6 | 384 | |
| Locks, in cases, packed | 31 | 6 | 186 | |
| Machinery, Light | 20 | 8 | 160 | 300 |
| Plumbing, Fixtures | 30 | 8 | 240 | to |
| Plumbing, Supplies | 55 | 6 | 330 | 400 |
| Sash Fasteners | 48 | 6 | 288 | |
| Screws | 101 | 6 | 606 | |
| Shafting Steel | 125 | | | |
| Sheet Tin, in boxes | 278 | 2 | 556 | |
| Tools, Small, Metal | 75 | 6 | 450 | |
| Wire Cables, on reels | | | 425 | |
| Wire, Insulated Copper, in coils | 63 | 5 | 315 | |
| Wire, Galvanized Iron, in coils | 74 | 4½ | 333 | |
| Wire, Magnet, on spools | 75 | 6 | 450 | |
| **Miscellaneous** | | | | |
| Automobile Tires | 30 | 6 | 180 | |
| Automobiles, uncrated | 8 | | 64 | |
| Books (solidly packed) | 65 | 6 | 390 | |
| Furniture | 20 | | | |
| Glass and Chinaware, in crates | 40 | 8 | 320 | |
| Hides and Leather, in bales | 20 | 8 | 160 | |
| Hides, Buffalo, in bundles | 37 | 8 | 296 | |
| Leather and Leather Goods | 40 | 8 | 320 | |
| Paper, Newspaper, and Strawboards | 35 | 6 | 210 | |
| Paper, Writing and Calendared | 60 | 6 | 360 | |
| Rope, in coils | 32 | 6 | 192 | |
| Rubber, Crude | 50 | 8 | 400 | |
| Tobacco, bales | 35 | 8 | 280 | |

# CORRUGATED SHEETS

## DIMENSIONS

| Corrugations | | | | Sheets | | Length of Sheet in Inches | Area in Sq. Feet of One Sheet | | | Number of Sheets in 100 Sq. Feet | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Width in Inches | | Depth in Inches | Number per Sheet | Full Sheet Width | Covering Width | | Corrugations | | | Corrugations | | | |
| Nominal | Actual | | | | | | 5″ | 2″, 2½″ 3″ | ⅝″ 1¼″ | 5″ | 2″, 2½″ 3″ | ⅝″ 1¼″ | |
| 5 | 5 | 7/8 | 6 | 28 | 25 | 60 | 11.67 | 10.83 | 10.42 | 8.57 | 9.23 | 9 60 | |
| 3 | 3 | 9/16 | 9 | 26 | 24 | 72 | 14.00 | 13.00 | 12.50 | 7.14 | 7.69 | 8 00 | |
| *2½ | 2⅔ | ½ | 10½ | 27½ | 24 | 84 | 16.33 | 15.17 | 14.58 | 6.12 | 6 59 | 6.86 | |
| 2½ | 2⅔ | ½ | 10 | 26 | 24 | 96 | 18.67 | 17.33 | 16 67 | 5.36 | 5.77 | 6.00 | |
| 2 | 2 | 7/16 | 13 | 26 | 24 | 108 | 21.00 | 19.50 | 18.75 | 4.76 | 5 13 | 5.33 | |
| 1¼ | 1¼ | 3/8 | 20 | 25 | 23¾ | 120 | 23 33 | 21.67 | 20.83 | 4 29 | 4.62 | 4.80 | |
| ⅝ | ⅝ | 3/16 | 40 | 25 | 24⅜ | 144 | 28 00 | 26.00 | 25 00 | 3.57 | 3.85 | 4.00 | |

*Sizes given are for 27½″ width.
5, 6, 7, 8, 9 and 10 feet are Standard lengths. Maximum length is 12 ft. except for ⅝″.

## WEIGHTS

Pounds per 100 Square Feet

Painted Sheets

| Corrugations | Thickness, United States Standard Gage | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12 | 14 | 16 | 18 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 5 | ... | 470 | 336 | 269 | 215 | 162 | 148 | 135 | 122 | 108 | 95 | 81 | 75 | 68 | .. |
| 3 | ... | 472 | 338 | 270 | 216 | 163 | 149 | 136 | 122 | 109 | 95 | 82 | 75 | 68 | .. |
| *2½ | 615 | 478 | 342 | 274 | 219 | 165 | 151 | 137 | 124 | 110 | 97 | 83 | 76 | 69 | .. |
| 2½ | 607 | 472 | 338 | 270 | 216 | 163 | 149 | 136 | 122 | 109 | 95 | 82 | 75 | 68 | .. |
| 2 | ... | ... | ... | 270 | 216 | 163 | 149 | 136 | 122 | 109 | 95 | 82 | 75 | 68 | .. |
| 1¼ | ... | ... | ... | ... | .. | 169 | 155 | 141 | 127 | 113 | 99 | 85 | 78 | 71 | .. |
| ⅝ | ... | ... | ... | ... | ... | ... | ... | ... | ... | 113 | 99 | 85 | 78 | 71 | .. |

Galvanized Sheets

| Corrugations | Thickness, United States Standard Gage | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12 | 14 | 16 | 18 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 5 | ... | 486 | 352 | 285 | 231 | 178 | 164 | 151 | 137 | 124 | 111 | 97 | 90 | 84 | 77 |
| 3 | ... | 488 | 353 | 286 | 232 | 178 | 165 | 151 | 138 | 125 | 111 | 98 | 91 | 84 | 77 |
| *2½ | 631 | 494 | 358 | 290 | 235 | 181 | 167 | 153 | 140 | 126 | 113 | 99 | 92 | 85 | 78 |
| 2½ | 623 | 488 | 353 | 286 | 232 | 178 | 165 | 151 | 138 | 125 | 111 | 98 | 91 | 84 | 77 |
| 2 | .. | ... | .. | 286 | 232 | 178 | 165 | 151 | 138 | 125 | 111 | 98 | 91 | 84 | 77 |
| 1¼ | ... | .. | ... | ... | ... | 186 | 172 | 158 | 144 | 130 | 116 | 102 | 95 | 88 | 81 |
| ⅝ | ... | .. | ... | ... | ... | ... | ... | ... | ... | 130 | 116 | 102 | 95 | 88 | 81 |

The weights given in the above tables are for actual dimensions and do not include allowances for end or side laps.

## NUMBER OF SQUARE FEET REQUIRED

2½″ Standard Sheets to cover Area of 100 Square Feet

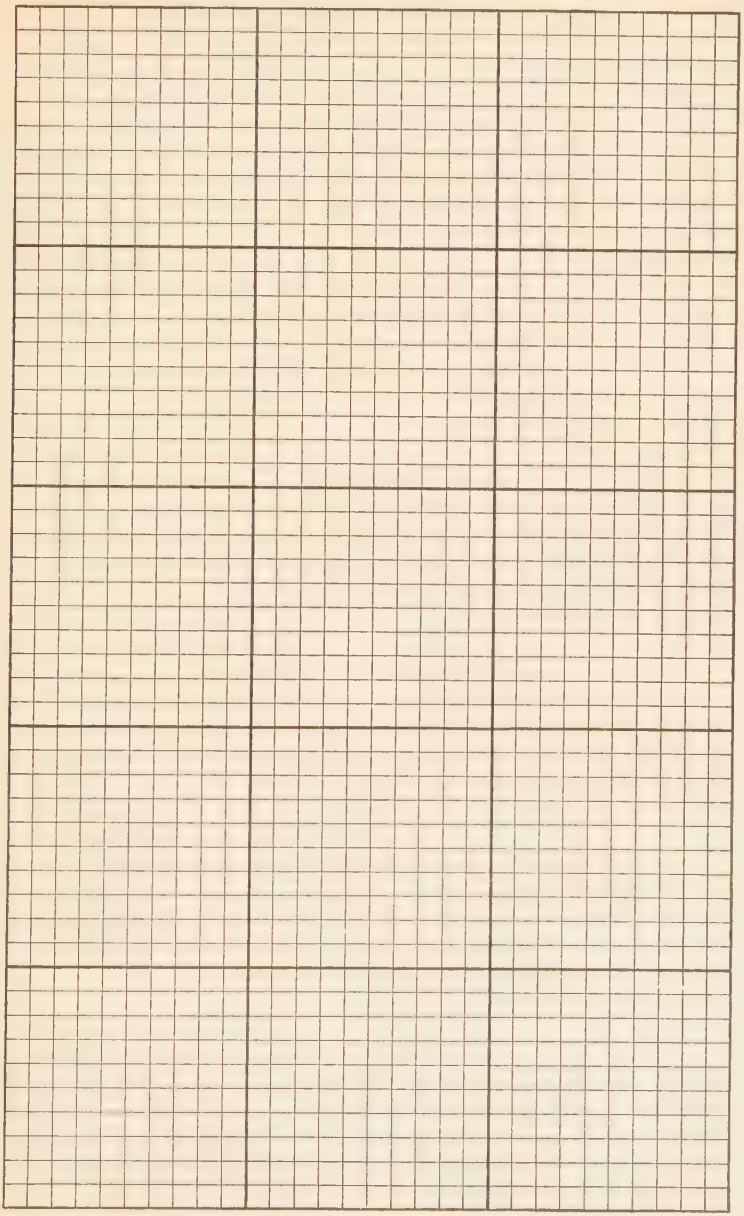
| Side Lap | | End Lap in Inches | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of Corrugations | 1 | 109 | 111 | 112 | 113 | 114 | 116 |
| | 1½ | 116 | 117 | 118 | 120 | 121 | 122 |
| | 2 | 123 | 124 | 126 | 127 | 129 | 130 |

The above table is based on the use of standard widths of sheets 96 inches long.
If longer or shorter sheets are used the number of square feet given will vary accordingly.

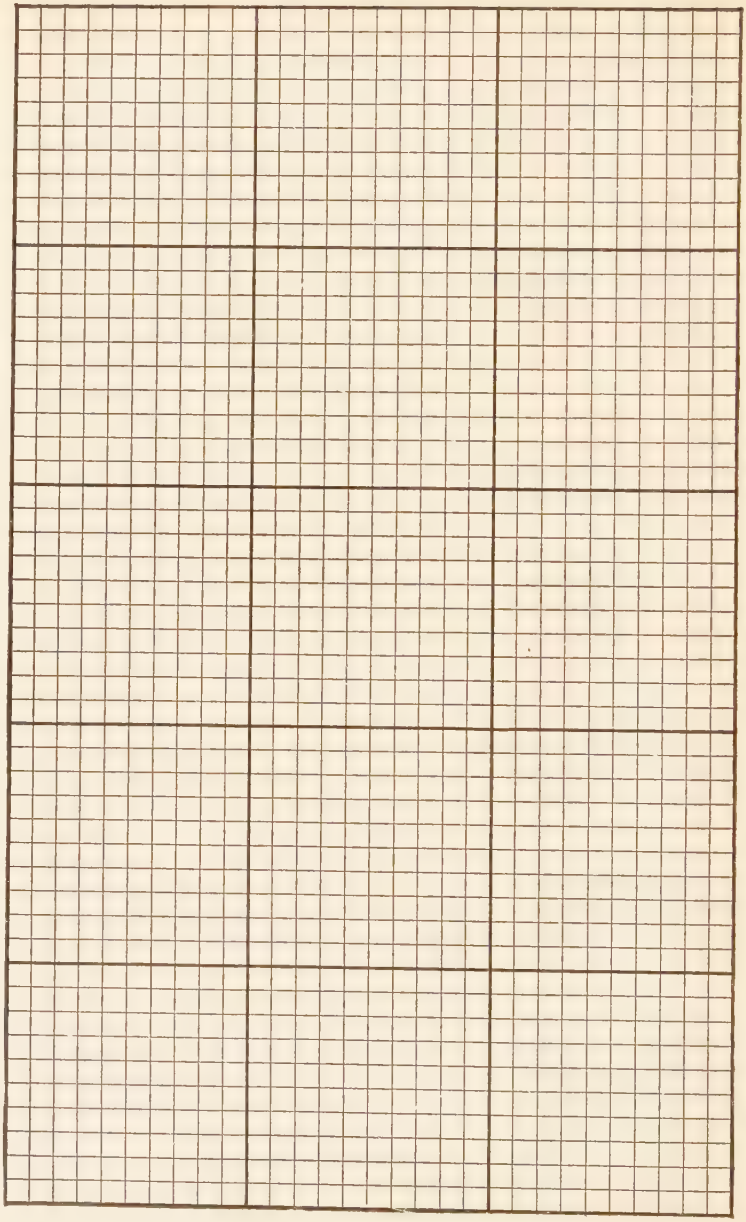
Laps: In standard roof construction one and one-half corrugations are allowed for lap in the width of the sheet and six inches in the length.

In standard siding construction one corrugation is allowed for lap in the width of the sheet and four inches in the length.

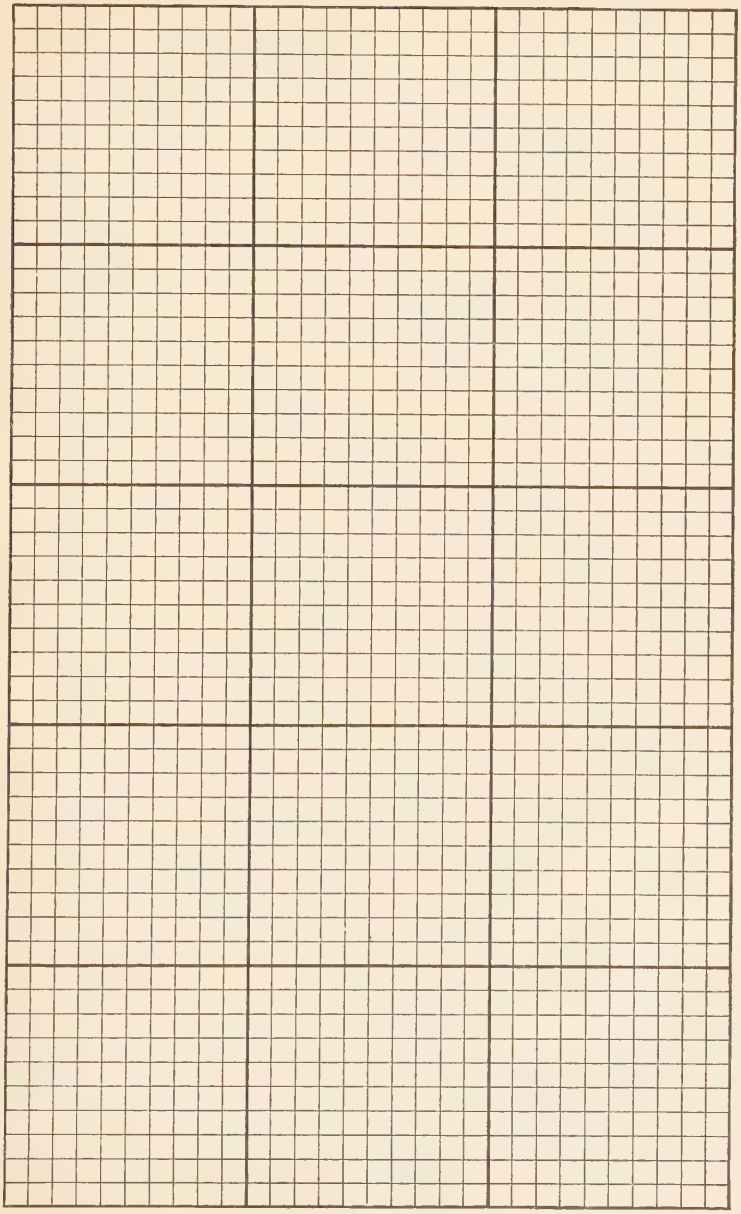
## NOTES and DIAGRAMS



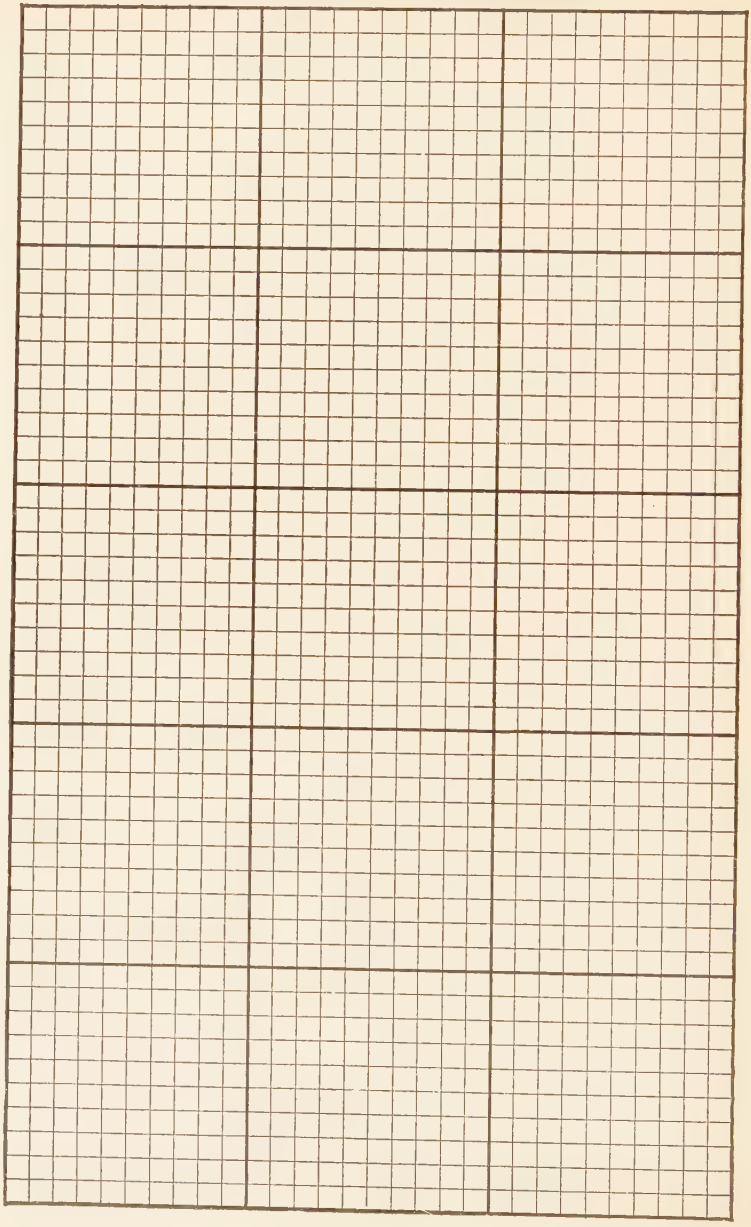
## NOTES and DIAGRAMS



## NOTES and DIAGRAMS



## NOTES and DIAGRAMS



# Part IV

## Structural Shapes and Details

**Explanation of Specification Formulae**

**Angles**

**Channels**

**Beams**

American Standard

Bethlehem

Carnegie

Miscellaneous Beam Sections

**Beam Summary**

**Columns**

Bethlehem

Carnegie

Plate and Angle

Plate and Channel

**Miscellaneous Sections**

**Base Plates**

**Rivets and Bolts**

# A. I. S. C. SPECIFICATION FORMULAE

In 1923 the American Institute of Steel Construction undertook the work of promoting uniform practice in the industry, and in order that its efforts would not be interpreted as being unduly influenced by commercial interests it selected a committee from among the leading talent in the academic, engineering and architectural professions to prepare a Standard Specification on the Design, Fabrication, and Erection of Structural Steel. This committee represented a combined experience of approximately one hundred and fifty years in an industry which is not more than thirty-five years old. The personnel was as follows:

| | |
|---|---|
| GEORGE F. SWAIN: | M. Am Soc C E—M. Am Soc M E—M. Inst C E M. A R E A—Past President, A S C E—Professor of Civil Engineering, Harvard University |
| MILO S. KETCHUM: | M. Am Soc C E—M. A R E A—Dean of the College of Engineering, and Director of the Engineering Experiment Station of the University of Illinois |
| E. R. GRAHAM: | of Graham, Anderson, Probst & White, Architects, Chicago, Ill. |
| W. J. THOMAS: | M. Am Soc C E—Chief Engineer, Geo. B. Post & Sons, Architects, N. Y. |
| WILBUR J. WATSON: | M. Am Soc C E—M. A R E A—President, Watson Engineering Company, Cleveland, Ohio |

It was recognized in their deliberations that the misleading term of "factor of safety" was more the subject of the application of any recommended unit stress than the unit stress itself. They did not undertake to define the qualities and property of steel, which is a proper function of the American Society for Testing Materials, but restricted themselves to a definition of the uses of steel in connection with building construction.

On the following pages is a mathematical explanation of the development of the various formulae recommended in the Specification for the proper reduction of working stresses. The diagram showing various column formulae indicates that a wide difference of opinion has existed on the proper consideration of this subject.

# Part IV
# Section 1

## Explanation of
## A. I. S. C. Specification Formulae

Beams

Web Shear and Stiffeners

Laterally Unsupported Flanges

Columns

Rivet Stresses

## A. I. S. C. Connection Angles

## BEAMS—ALLOWABLE STRESSES

### (A. I. S. C. Specification)

All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per sq. in. shall not exceed the following:—

**Shearing**

On the gross area of the webs of beams and girders, where $h$, the height between flanges in inches, is not more than 60 times $t$, the thickness of the web in inches . . . . . 12000

On the gross area of the webs of beams and girders if the web is not stiffened where $h$, the height between flanges in inches, is more than 60 times $t$, the thickness of the web, the maximum shear per square inch, $\frac{V}{A}$ shall not exceed $\frac{18000}{1 + \frac{h^2}{7200t^2}}$

In which V is the total shear, and A is gross area of web in square inches.

**Stiffeners**

Stiffeners shall be required on the webs of rolled beams and plate girders at the ends and at points of concentrated loads, and at other points where $h$ the clear distance between flanges is greater than $85t\sqrt{18000\ (A/V)-1}$, in which $t$ is the thickness of the web. When stiffeners are required, the distance in inches between them shall not be greater than $85t\sqrt{18000\ (A/V)-1}$, or not greater than 6 feet. When $h$ is greater than 60 times $t$ the thickness of the web of a plate girder, stiffeners shall be required at distances not greater than 6 feet apart. Stiffeners under or over concentrated loads shall be proportioned to distribute such loads into the web.

## BEAMS—WEB SHEAR AND STIFFENERS

The development of formulae appearing in the Specification on this subject is based upon the accepted theory that the vertical shear in the webs of beams and girders may be properly resolved at 45° to the axis of the beam or girder, or at right angles to each other. Numerous tests have been made on beams and girders in which they have been loaded beyond their elastic limit with the result that the mill surface of the material has been broken down along the lines on which the interior material has been distorted. These lines have been photographed and confirm the theory exactly. They indicate that the webs of rolled beams act as multiple lattice trusses, and that riveted plate and angle girders act as pin connected trusses. These strain lines show the stresses acting at exactly 45° to the neutral axis. If the web of a beam or girder

is to fail by buckling this failure would of course develop as a result of the compression stresses acting at 45° to the axis of the girder; and the length of the column would be the square root of $2h^2$ where $h$ is the height between flanges. Over a long period it has been established that until this height is more than 60 times the thickness of the web, there is no danger from buckling. The formula representing the crippling strength of the web is developed as follows:

$f_c$ = average intensity of the allowable compression stress equal 18,000 #
$f_s$ = average intensity of the vertical shear per square inch on the gross section of the web equals 12,000 #
$l$ = length of the compression fibre at 45° between the stiffeners or the flanges, whichever is the smaller.
A = gross area of the web in square inches
V = gross vertical shear on the web
$h$ = distance between flanges or stiffeners, whichever is the smaller
$t$ = thickness of the web
$r$ = least radius of gyration of the web

Therefore, $r = t/\sqrt{12}$ and $l = \sqrt{2h^2}$

The column formula applied to the web of a girder would then be

$$f_s = \frac{f_c}{1 + \frac{l^2}{cr^2}} = \frac{f_c}{1 + \frac{h^2}{c_1 t^2}}$$

$c$ is a constant applying when the ratio $l/r$ is used, and $c_1$ is a corresponding constant applying when $h/t$ is used.

Solving this equation for $h^2/t^2$ we have,

$$\frac{h^2}{t^2} = c_1 \left( \frac{f_c}{f_s} - 1 \right)$$

It is now necessary to determine the value of the constant $c_1$. Conceding the fact that stiffeners are not needed inside the points where $h/t$ equals 60, we may substitute in this formula and get,

$$3600 = c_1 \left( \frac{18000}{12000} - 1 \right)$$

and solving this we have,

$$c_1 = 7200$$

The column formula for web crippling then becomes,

$$\frac{V}{A} = \frac{18000}{1 + \frac{h^2}{7200\, t^2}}$$

and solving this, we have,

$$h = 85\, t \sqrt{18000 \frac{A}{V} - 1}$$

By this analysis and treatment of the webs of beams and girders, we are enabled to so space the stiffeners on a web ½″ thick as to give it the same resistance to buckling as a web 1″ thick would have. It is, of course, obvious that we cannot make the shear of a ½″ web equivalent to the shear of a 1″ web; but we have taken the subject out of the empirical treatment and placed it on a rational basis.

On the opposite page is a chart devised to eliminate the necessity of calculations in finding the allowable vertical shear in the webs of beams and girders, and it also gives the proper spacing of web stiffeners.

The oblique lines through the points on the line which is the scale representing web thickness in inches all pass through zero. These lines intersect verticals from the base line giving the scale of $h$. The horizontal lines from this intersection give the ratio $h/t$ on the left of the chart and where this horizontal line crosses the curve, gives the allowable shear per square inch in the web, which is read at the top of the chart. By reversing the process, the proper distance between stiffeners is given.

***Example:—***

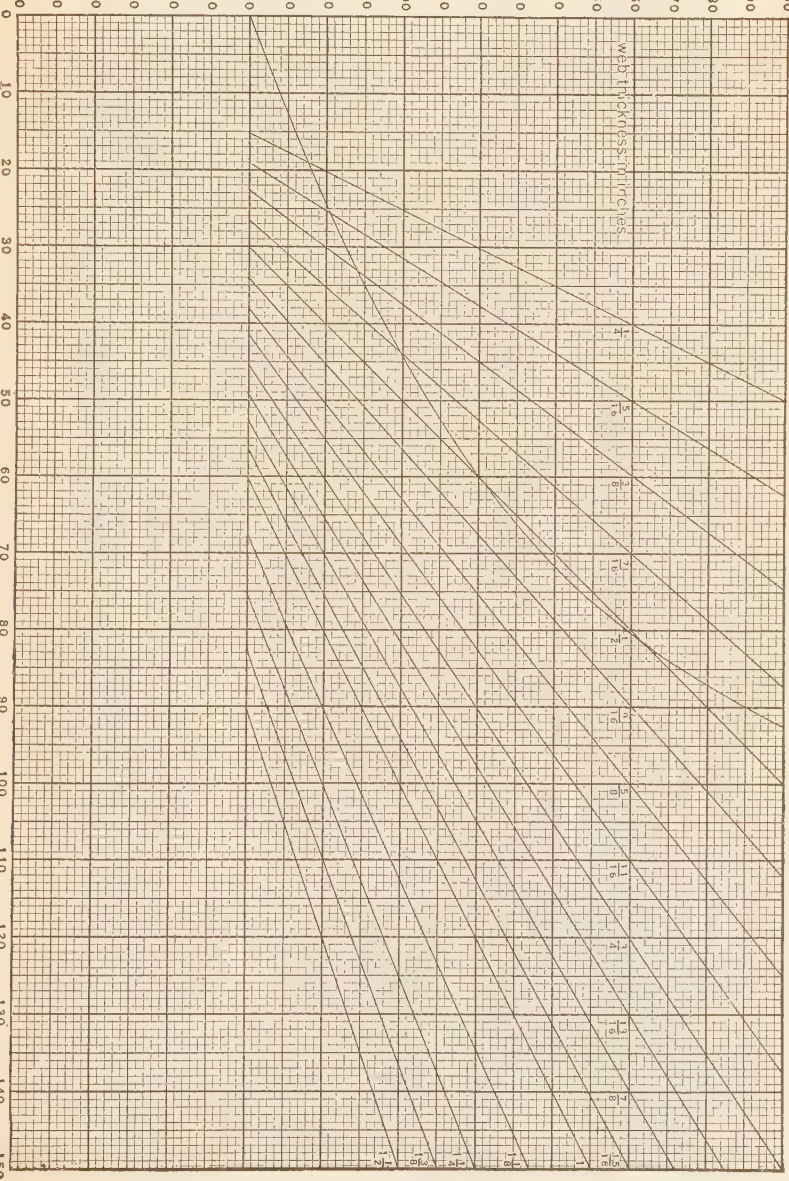
9000 pounds per square inch shear is permitted when $h/t$ equals 85; and if $t$ is ½ inch $h$ = 42 inches, which is the maximum distance between stiffeners if the distance between flanges is more than 42 inches.

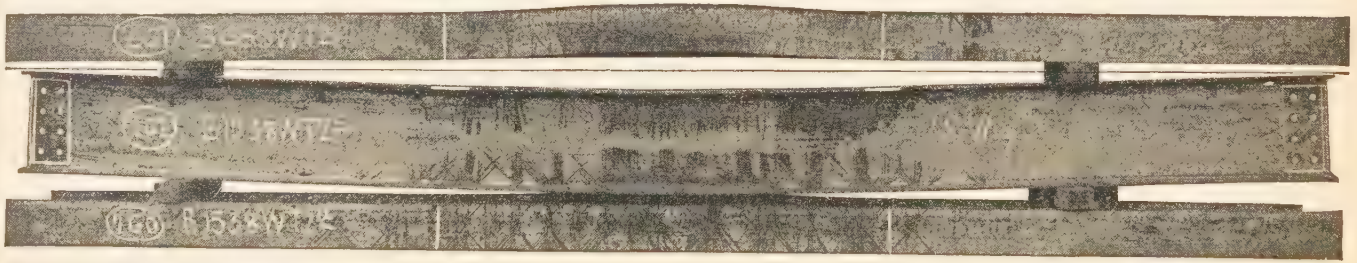
Below is given the allowable shear per square inch for various ratios of $h/t$.

| $h/t$ | $V/A$ | $h/t$ | $V/A$ | $h/t$ | $V/A$ | $h/t$ | $V/A$ |
|---|---|---|---|---|---|---|---|
| 60 | 12000 | 74 | 10224 | 87 | 8775 | 100 | 7535 |
| 61 | 11868 | 75 | 10105 | 88 | 8672 | 105 | 7111 |
| 62 | 11734 | 76 | 9988 | 89 | 8571 | 110 | 6722 |
| 63 | 11604 | 77 | 9871 | 90 | 8471 | 115 | 6345 |
| 64 | 11473 | 78 | 9756 | 91 | 8372 | 120 | 6000 |
| 65 | 11343 | 79 | 9642 | 92 | 8274 | 125 | 5678 |
| 66 | 11215 | 80 | 9529 | 93 | 8177 | 130 | 5378 |
| 67 | 11087 | 81 | 9418 | 94 | 8082 | 135 | 5097 |
| 68 | 10961 | 82 | 9308 | 95 | 7988 | 140 | 4836 |
| 69 | 10835 | 83 | 9199 | 96 | 7895 | 145 | 4592 |
| 70 | 10711 | 84 | 9091 | 97 | 7803 | 150 | 4364 |
| 71 | 10587 | 85 | 8984 | 98 | 7712 | 155 | 4151 |
| 72 | 10465 | 86 | 8880 | 99 | 7623 | 160 | 3951 |
| 73 | 10344 | | | | | | |

## WEB SHEAR AND STIFFENERS CHART

ratio $\frac{h}{t}$. $h$ and $t$ both in inches.

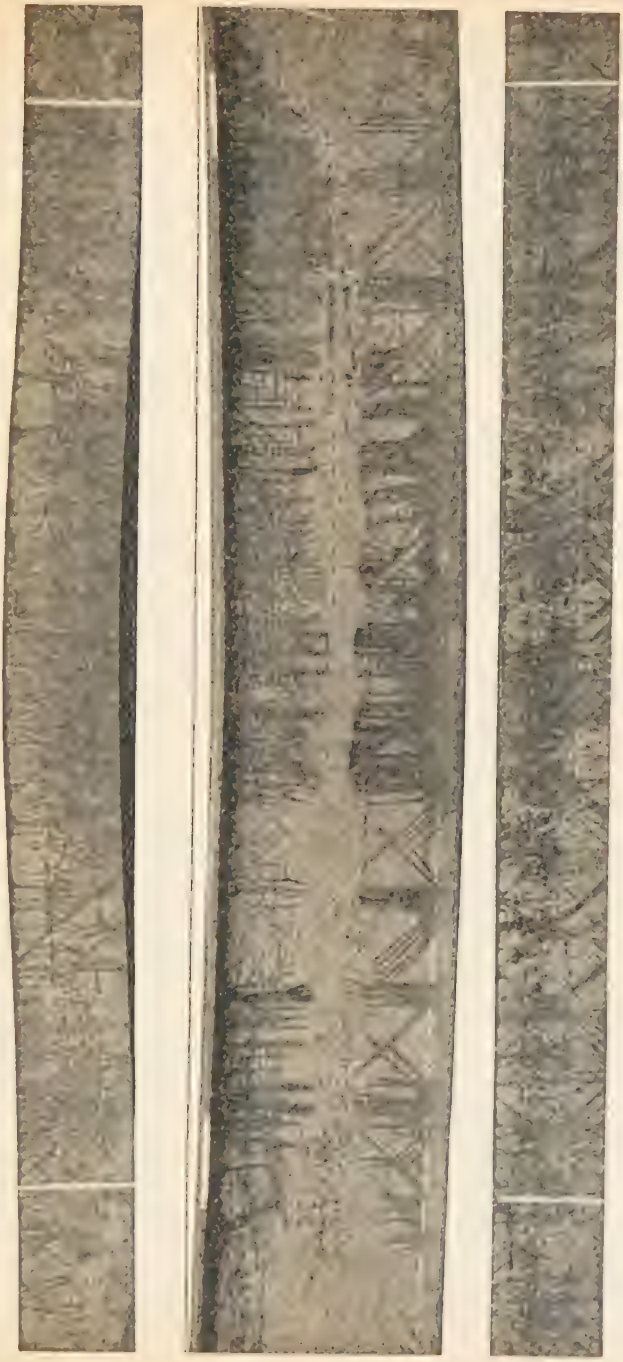




The above illustration is a picture of a 15 inch—38 pound beam 15 feet—11¾ inches long which has been loaded at the third points as indicated by the white marks.

There is a picture of a top and bottom flange shown from which it will be seen that the failure was due to buckling of the compression flange. The line drawn above the beam indicates the permanent set; and the lines on the web are the strain lines which are shown more clearly on an enlarged cut on the next page.

No paint was used on any of these beams, and the cracks in the mill scale are the result of strains beyond the elastic limit of the material.



Enlarged photo of web stress shown on the opposite page.

The above illustration is a picture of a plate and angle girder 27 feet 11½ inches long, fabricated from a 30 x ⅜ inch web plate; and flange angles 6 x 4 x ¾ for the top flange and 6 x 4 x ½ for the bottom flange.

The loads were applied at the third points over the stiffeners and the line drawn above the beam shows the permanent set after the girder was removed from the testing machine. Strain lines are plainly visible radiating at exactly 45° from the various rivets.

## BEAMS—ALLOWABLE STRESSES

### (A. I. S. C. Specification)

All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per sq. in. shall not exceed the following:—

**Bending**

On extreme fibres of rolled shapes, and built up sections, net section, if lateral deflection is prevented . . . . . 18000

When the unsupported length $l$ exceeds 15 times $b$, the width of the compression flange, the stress in pounds per sq. in. in the latter shall not exceed

$$\frac{20000}{1 + \frac{l^2}{2000b^2}}$$

The laterally unsupported length of beams and girders shall not exceed 40 times $b$ the width of the compression flange.

## BEAMS—LATERALLY UNSUPPORTED FLANGES

The question of the stresses in laterally unsupported flanges is of vital importance in the proper design of beams and girders. It is recognized of course, that this flange stress does not exist as uniform through the full length of a beam or girder flange, and is therefore properly entitled to somewhat higher unit stresses than the direct use of the column formula would permit. Practice over many years has established that it should be unnecessary to reduce the allowable stress in the compression flange until the length of this unsupported flange is more than 15 times its width. On this basis the 18,000 pound unit stress is permitted up to the point where $l/b$ is 15, and is reduced by the column formula curve beyond this point. The constant in the denominator of this curve is determined as in the other two formulae by drawing a curve which starts at 20,000 and passes through 18,000 at 15 $l/b$.

The A. I. S. C. Specification has, in the treatment of this subject, eliminated a large part of the empirical formulae which have existed in the past. It might be advocated that a straight line formula would as satisfactorily answer the purpose, but it should be remembered that such a straight line formula does not contain any factor which can be interpreted as representing failure by flexure. In addition to this, the use of any formula depends upon the engineer having before him the tabulated properties of the sections to be used, and if this tabulation is necessary in the straight line formula, it would be just as consistent to carry the calculations one stage further and give the allowable unit stress, thus eliminating the chances of errors in calculation.

On the page opposite is given a chart for determining the per cent of the allowable uniform load which various compression flanges may carry if laterally unsupported. The maximum allowable load is that which produces a flange stress of 18000 pounds per square inch on the beam or girder when laterally supported. The formula is,

$$f_c = \frac{20000}{1 + \frac{l^2}{2000\, b^2}}$$

In which

$fc$ = allowable compression stress in pounds per square inch:
$l$ = unsupported length of the compression flange in inches.
$b$ = width of the flange in inches.

The oblique lines pass through the flange width scale given in inches and zero.

These lines intersect verticals from the span given in feet. The horizontal line from this intersection gives the ratio $l/b$ on the left of the chart; and where this horizontal line crosses the percentage line, is the per cent of a laterally supported beam load which the same beam will carry if laterally unsupported.

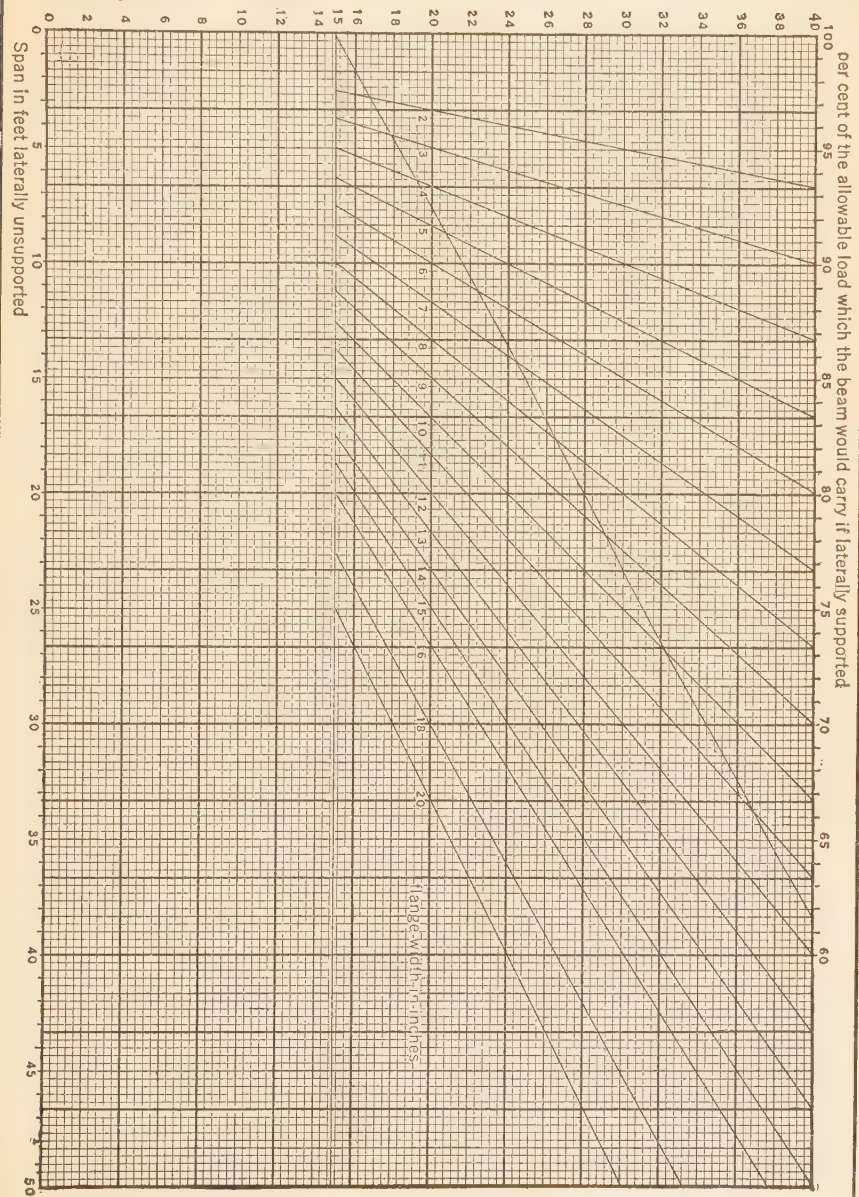
***Example:—***

A flange 6 inches wide on a laterally unsupported span of 15 feet has $l/b$ equal to 30, and it will carry 76½% of the load of the same beam if it is laterally supported. The chart also gives the spans where the reduction of flange stress is required, and the maximum spans for laterally unsupported flanges.

A table giving the allowable flange stress and percentage of fixed beam loads for beams with laterally unsupported flanges is given on the page immediately following the chart.

## LATERALLY UNSUPPORTED FLANGES

ratio $\frac{l}{b}$. $l$ and $b$ both in inches.


Span in feet laterally unsupported
per cent of the allowable load which the beam would carry if laterally supported
flange-width-in-inches

# BEAMS AND GIRDERS WITH LATERALLY UNSUPPORTED FLANGES

## ALLOWABLE STRESS, IN POUNDS PER SQ. INCH, IN EXTREME FIBRE FOR VARIOUS RATIOS OF $l/b$

| $\frac{l}{b}$ | Fibre Stress | $\frac{l}{b}$ | Fibre Stress | $\frac{l}{b}$ | Fibre Stress | $\frac{l}{b}$ | Fibre Stress | $\frac{l}{b}$ | Fibre Stress |
|---|---|---|---|---|---|---|---|---|---|
| 15.0 | 18000 | 20.0 | 16667 | 25.0 | 15238 | 30.0 | 13793 | 35.0 | 12403 |
| 16.0 | 17730 | 21.0 | 16387 | 26.0 | 14948 | 31.0 | 13509 | 36.0 | 12136 |
| 17.0 | 17475 | 22.0 | 16103 | 27.0 | 14657 | 32.0 | 13228 | 37.0 | 11873 |
| 18.0 | 17212 | 23.0 | 15817 | 28.0 | 14368 | 33.0 | 12949 | 38.0 | 11614 |
| 19.0 | 16942 | 24.0 | 15528 | 29.0 | 14080 | 34.0 | 12674 | 39.0 | 11360 |
| | | | | | | | | 40.0 | 11111 |

## PERCENTAGE OF FIXED BEAM LOADS FOR VARIOUS RATIOS OF $l/b$

| $\frac{l}{b}$ | % | $\frac{l}{b}$ | % | $\frac{l}{b}$ | % | $\frac{l}{b}$ | % | $\frac{l}{b}$ | % |
|---|---|---|---|---|---|---|---|---|---|
| 15.0 | 100.00 | 20.0 | 92.58 | 25.0 | 84.65 | 30.0 | 76.63 | 35.0 | 68.90 |
| 15.1 | 99.74 | 20.1 | 92.43 | 25.1 | 84.49 | 30.1 | 76.47 | 35.1 | 68.76 |
| 15.2 | 99.61 | 20.2 | 92.28 | 25.2 | 84.33 | 30.2 | 76.31 | 35.2 | 68.61 |
| 15.3 | 99.47 | 20.3 | 92.13 | 25.3 | 84.17 | 30.3 | 76.15 | 35.3 | 68.46 |
| 15.4 | 99.33 | 20.4 | 91.97 | 25.4 | 84.01 | 30.4 | 75.99 | 35.4 | 68.31 |
| 15.5 | 99.19 | 20.5 | 91.82 | 25.5 | 83.85 | 30.5 | 75.84 | 35.5 | 68.16 |
| 15.6 | 99.06 | 20.6 | 91.66 | 25.6 | 83.69 | 30.6 | 75.68 | 35.6 | 68.01 |
| 15.7 | 98.93 | 20.7 | 91.50 | 25.7 | 83.53 | 30.7 | 75.52 | 35.7 | 67.86 |
| 15.8 | 98.78 | 20.8 | 91.35 | 25.8 | 83.37 | 30.8 | 75.36 | 35.8 | 67.72 |
| 15.9 | 98.64 | 20.9 | 91.19 | 25.9 | 83.20 | 30.9 | 75.21 | 35.9 | 67.57 |
| 16.0 | 98.50 | 21.0 | 91.04 | 26.0 | 83.04 | 31.0 | 75.05 | 36.0 | 67.42 |
| 16.1 | 98.36 | 21.1 | 90.88 | 26.1 | 82.88 | 31.1 | 74.89 | 36.1 | 67.27 |
| 16.2 | 98.22 | 21.2 | 90.72 | 26.2 | 82.72 | 31.2 | 74.74 | 36.2 | 67.13 |
| 16.3 | 98.08 | 21.3 | 90.56 | 26.3 | 82.55 | 31.3 | 74.58 | 36.3 | 66.98 |
| 16.4 | 97.94 | 21.4 | 90.41 | 26.4 | 82.39 | 31.4 | 74.42 | 36.4 | 66.83 |
| 16.5 | 97.80 | 21.5 | 90.25 | 26.5 | 82.23 | 31.5 | 74.26 | 36.5 | 66.69 |
| 16.6 | 97.65 | 21.6 | 90.09 | 26.6 | 82.07 | 31.6 | 74.11 | 36.6 | 66.54 |
| 16.7 | 97.51 | 21.7 | 89.93 | 26.7 | 81.91 | 31.7 | 73.95 | 36.7 | 66.39 |
| 16.8 | 97.37 | 21.8 | 89.78 | 26.8 | 81.75 | 31.8 | 73.79 | 36.8 | 66.25 |
| 16.9 | 97.23 | 21.9 | 89.62 | 26.9 | 81.59 | 31.9 | 73.64 | 36.9 | 66.11 |
| 17.0 | 97.08 | 22.0 | 89.46 | 27.0 | 81.43 | 32.0 | 73.48 | 37.0 | 65.96 |
| 17.1 | 96.94 | 22.1 | 89.30 | 27.1 | 81.27 | 32.1 | 73.33 | 37.1 | 65.82 |
| 17.2 | 96.80 | 22.2 | 89.14 | 27.2 | 81.11 | 32.2 | 73.17 | 37.2 | 65.67 |
| 17.3 | 96.65 | 22.3 | 88.98 | 27.3 | 80.94 | 32.3 | 73.02 | 37.3 | 65.53 |
| 17.4 | 96.50 | 22.4 | 88.82 | 27.4 | 80.78 | 32.4 | 72.86 | 37.4 | 65.38 |
| 17.5 | 96.35 | 22.5 | 88 66 | 27.5 | 80.62 | 32.5 | 72.71 | 37.5 | 65.24 |
| 17.6 | 96.21 | 22.6 | 88.51 | 27.6 | 80.46 | 32.6 | 72.55 | 37.6 | 65.09 |
| 17.7 | 96.06 | 22.7 | 88.35 | 27.7 | 80.30 | 32.7 | 72.40 | 37.7 | 64.95 |
| 17.8 | 95.92 | 22.8 | 88.19 | 27.8 | 80.14 | 32.8 | 72.25 | 37.8 | 64.81 |
| 17.9 | 95.77 | 22.9 | 88.03 | 27.9 | 79.98 | 32.9 | 72.09 | 37.9 | 64.67 |
| 18.0 | 95.62 | 23.0 | 87.87 | 28.0 | 79.82 | 33.0 | 71.94 | 38.0 | 64.52 |
| 18.1 | 95.47 | 23.1 | 87.71 | 28.1 | 79.66 | 33.1 | 71.78 | 38.1 | 64.38 |
| 18.2 | 95 33 | 23.2 | 87.55 | 28.2 | 79.50 | 33.2 | 71.63 | 38.2 | 64.24 |
| 18.3 | 95.17 | 23.3 | 87.39 | 28.3 | 79.34 | 33.3 | 71.48 | 38.3 | 64.09 |
| 18.4 | 95.02 | 23.4 | 87.23 | 28.4 | 79.18 | 33.4 | 71.32 | 38.4 | 63.96 |
| 18.5 | 94.87 | 23.5 | 87.07 | 28.5 | 79.02 | 33.5 | 71.17 | 38.5 | 63.81 |
| 18.6 | 94.72 | 23.6 | 86.91 | 28.6 | 78.86 | 33.6 | 71.02 | 38.6 | 63.67 |
| 18.7 | 94.57 | 23.7 | 86.75 | 28.7 | 78.69 | 33.7 | 70.87 | 38.7 | 63.53 |
| 18.8 | 94.43 | 23.8 | 86.59 | 28.8 | 78.53 | 33.8 | 70.72 | 38.8 | 63.39 |
| 18.9 | 94.27 | 23.9 | 86.43 | 28.9 | 78.38 | 33.9 | 70.56 | 38.9 | 63.25 |
| 19.0 | 94.12 | 24.0 | 86.27 | 29.0 | 78.22 | 34.0 | 70.41 | 39.0 | 63.11 |
| 19.1 | 93.97 | 24.1 | 86.11 | 29.1 | 78.06 | 34.1 | 70.26 | 39.1 | 62.97 |
| 19.2 | 93.82 | 24.2 | 85.94 | 29.2 | 77.90 | 34.2 | 70.11 | 39.2 | 62.83 |
| 19.3 | 93.66 | 24.3 | 85.78 | 29.3 | 77.74 | 34.3 | 69.96 | 39.3 | 62.69 |
| 19.4 | 93.51 | 24.4 | 85.62 | 29.4 | 77.58 | 34.4 | 69.80 | 39.4 | 62.55 |
| 19.5 | 93.36 | 24.5 | 85.46 | 29.5 | 77.42 | 34.5 | 69.65 | 39.5 | 62.42 |
| 19.6 | 93 20 | 24.6 | 85.30 | 29.6 | 77.26 | 34.6 | 69.50 | 39.6 | 62.27 |
| 19.7 | 93.05 | 24.7 | 85.14 | 29.7 | 77.10 | 34.7 | 69.35 | 39.7 | 62.14 |
| 19.8 | 92.90 | 24.8 | 84.98 | 29.8 | 76.94 | 34.8 | 69.21 | 39.8 | 62.00 |
| 19.9 | 92.75 | 24.9 | 84.81 | 29.9 | 76.78 | 34.9 | 69.05 | 40.0 | 61.72 |

$l$ = the unsupported length, in inches, of the compression flange.

$b$ = the width of the flange in inches.

## COLUMNS—ALLOWABLE STRESSES

### (A. I. S. C. Specification)

All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per sq. in. shall not exceed the following:—

**Compression**

Rolled Steel, on short lengths or where lateral deflection is prevented ..... 18000

On gross section of columns ..... $\dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

with a maximum of ..... 15000

In which $l$ is the unsupported length of the column, and $r$ is the corresponding least radius of gyration of the section, both in inches. For main compression members, the ratio $l/r$ shall not exceed 120, and for bracing and other secondary members, 200.

## COLUMNS

One of the apparent defects in most curves representing column failures is the lack of consideration of the fact that steel in compression fails by one of three processes depending upon the ratio of slenderness. These three types of failure may be described as bearing, transverse crippling and flexure. Bearing failures occur in short specimens which can hardly be classed as columns in the usual meaning of the term, since a failure by bearing is evidenced by a lateral flow of the metal. It is of course, true that the physical evidence of bearing exists in all columns to the extent that the specimen is shortened and the area is increased by the lateral flow of the metal. As the ratio of slenderness increases, the action of bearing merges into a combination of shear and bearing on a plane inclined to the axis of the column, and this combination will be referred to as transverse crippling, which corresponds very closely to what is considered shear in the web of a beam or girder. Pure shear rarely exists in construction.

When the ratio of slenderness is small, and the specimen very short, the angle of the plane on which transverse failure occurs, is nearly at right angles to the direction of the compression stress, and the dominant condition of failure is bearing. This condition exists up to where $l/r$ is approximately 25. As the length increases, the angle of this plane of failure changes, the bearing stress decreases, and the shearing increases until the plane is 45° to the axis of stress, and at this point the intensity of shear is one-half the axial stress, or direct compression. Failure in columns does not occur on this 45° plane, but when the

angle between the axial stress and the plane is approximately 35° to 40°, and is the result of a combination of shear and bearing, referred to as crippling.

Professor Charles E. Greene in his book on Structural Mechanics (1897) analyzes conditions of transverse shear, and by experiment found that in granular material, such as cast iron, the angle of the plane of failure was about 35° to the axis. Due to the ductile properties of steel, complete fracture cannot be obtained in this type of failure. If failure by transverse crippling is sufficiently complete, the column folds up about the part where primary failure started instead of bowing from end to end as will occur when the failure is one of flexure. It may, however, occur that in the primary failure by crippling, the resulting eccentricity may cause the failure to merge into a flexural condition, and bow from end to end although the primary condition was one of crippling. This will explain why columns sometimes fail by flexure against the axis of their maximum strength in bending.

An examination of many column tests shows that failure by transverse crippling dominates until the ratio of slenderness $l/r$ is about 80 and sometimes more than 100. If it were possible to eliminate eccentricity, including metallurgical and mechanical inequalities both as regards the straightness of the column, and the application of the load, all columns would fail at practically uniform stress by transverse crippling. The elimination of mechanical and metallurgical eccentricities being impossible in commercial practice, means that when such eccentricities become sufficient, the columns will not fail by crippling, but by flexure; and to be consistent the formula for this flexure type of failure must include a factor representing flexure.

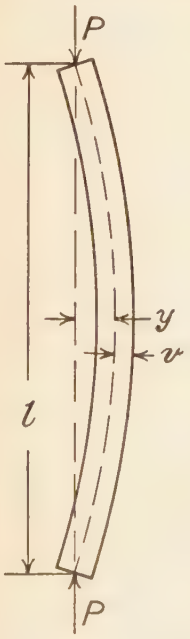
The American Institute of Steel Construction's Specification considers columns as resisting crippling (at 15,000 pounds per square inch), where $l/r$ is 60 or less, and reduces the allowable working stress by a flexure formula where $l/r$ is more than 60.

Confirming the uniformity with which columns fail under conditions of transverse crippling, the following records of test are given from which it will be seen that the strength corresponds to the yield point of the material.

| Soft Steel 1″ Thick | | | Medium Steel 2″ Thick | | |
|---|---|---|---|---|---|
| Length | $l/r$ | Ultimate Stress per sq. in. | Length | $l/r$ | Ultimate Stress per sq. in. |
| 12′0″ | 40.5 | 38,700 | 12′0″ | 38 | 43,800 |
| 12′0″ | 40.5 | 38,000 | 12′0″ | 38 | 45,000 |
| 12′0″ | 40.5 | 37,700 | 12′0″ | 38 | 45,000 |
| 24′0″ | 81 | 38,600 | 24′0″ | 76 | 42,000 |
| 24′0″ | 81 | 37,600 | 24′0″ | 76 | 42,500 |
| 24′0″ | 81 | 36,600 | 24′0″ | 76 | 43,600 |

While the point at which failure by flexure due to metallurgical and mechanical eccentricity is empirical, and starts somewhere about where $l/r$ is 80, the Specification is based on failures by transverse crippling ending where $l/r$ is 60, and beyond this reduces the allowable stress by a flexure formula which prevents an appreciable increase in the unknown initial eccentricity.

Such a formula for determining the maximum working stress should be obtained by combining the stress per square inch due to direct compression, and the stress per square inch due to flexure, making the sum of these two equal the maximum allowable stress. In connection with the diagram attached hereto:




$l$ = length of the column in inches.

$y$ = maximum deflection in inches from the line of action of the compression stress.

$v$ = distance in inches of the extreme fibre from the axis of the section through its center of gravity.

P = total load in compression.

A = area of the column in square inches.

I = moment of inertia of the column cross section $= Ar^2$

S = section modulus of the column $= \frac{I}{v} = \frac{Ar^2}{v}$,

$r$ = radius of gyration of the column cross section.

$f$ = maximum allowable stress intensity per square in.

The intensity of stress per square inch due to direct compression is then equal $\frac{P}{A}$.

The bending moment due to direct compression is $P\,y$.

The stress per sq. in. due to bending is $\frac{Py}{S} = \frac{Pyv}{Ar^2}$.

Then combining the stress per square inch from direct compression with the stress per square inch due to bending, we have,

$$f = \frac{P}{A} + \frac{P\,y\,v}{Ar^2} = \frac{P}{A}\left(1 + \frac{y\,v}{r^2}\right)$$

and solving this, we have

$$\frac{P}{A} = \frac{f}{1 + \frac{y\,v}{r^2}}$$

$$\frac{P}{A} = \frac{f}{1 + \frac{y\ v}{r^2}}$$

This formula must be correct within the elastic limit of the material if our theory of flexure is sound. It cannot, however, be used in this form because $y$ is unknown. It is, however, known that as $l$ increases $y$ will also increase. Also $yv$ is a distance times a distance in which $v$ is a constant. To retain the consistency of the equation in replacing the quantity $yv$, we must have it include a distance times a distance; and as $l$ is the distance, regulating the variation in $y$, we may properly introduce $cl^2$ to replace the quantity $yv$. In this factor $c$ includes the constant $v$, and the unknown ratio of $l$ to $y$. Substituting the quantity $cl^2$, we have the Rankine formula.

$$\frac{P}{A} = \frac{f}{1 + \frac{cl^2}{r^2}}$$

This substitution above referred to is reasonable, for as $v$ increases, other things being equal, $y$ must decrease, and as $l$ increases $y$ must increase in a greater ratio. If the length of the column increases while the cross section and $v$ remain the same, clearly $y$ would increase in a greater ratio.

It may be said that this formula contains one inherent inaccuracy, namely, that $c$ should really be a variable increasing with P. It is not practical to make $c$ a variable for designing purposes, and furthermore, the exact law of its variation has not been determined. The purpose of reducing the working stress is to make the variation of $c$ so small that it is negligible; it is therefore assumed a constant for practical purposes, and in this connection the use of the formula is limited for primary columns between the points $60\ l/r$ and $120\ l/r$; and for secondary members from $120\ l/r$ to $200\ l/r$. The determination of the constant in the denominator of this formula is as follows:

The maximum allowable stress in compression is 18000 pounds, and at $60\ l/r$ the maximum allowable working stress has been fixed at 15000 lbs.

From this we derive the equation,

$$15000 = \frac{18000}{1 + \frac{cl^2}{r^2}}$$

Substituting 60 for $l/r$, we have

$$15000 = \frac{18000}{1 + 3600\ c}$$

Solving this, we have

$$c = \frac{1}{18000}$$

and our formula then becomes,

$$\frac{P}{A} = f = \frac{18000}{1 + \frac{l^2}{18000 r^2}}$$

This provides a reduction in stress per square inch over the range in which the column is considered as failing through flexure.

It might be advocated that a straight line formula could be devised to give practically the same reductions for flexural conditions as the curve, but a comparative analysis of the two shows that the straight line is mathematically inconsistent. The straight line formula is,

$$\frac{P}{A} = f - \frac{cl}{r} \text{ or } f = \frac{P}{A} + \frac{cl}{r}$$

In the development of our formula we found $f$ equal to the sum of the direct load stress and the bending stress, or,

$$f = \frac{P}{A} + \frac{P\ y\ v}{A r^2}$$

From these formulae we have,

$$\frac{P y v}{A r^2} = \frac{cl}{r}$$

In this we find that $cl/r$ of the straight line formula is equal to the bending stress in our formula. This is not consistent, since on the left we have a stress per square inch times a ratio and on the right a constant times a ratio.

Furthermore, solving for $y$, we have,

$$y = \frac{cl A r}{P v}$$

In this we find that $y$ would increase if either A or $r$ were increased, which is the reverse of actual conditions; also if P were increased, $y$ would decrease, which is absurd.

The claim that a straight line formula is easier to operate is based upon the assumption that the operator has memorized the tables of radius of gyration and if he has not, the tabulation might consistently be carried one step further giving the unit stress and eliminating the chances for errors in computation.

On the page opposite is a chart which is devised to eliminate the necessity of tedious mathematical calculations to determine the allowable working stress in columns of various lengths.

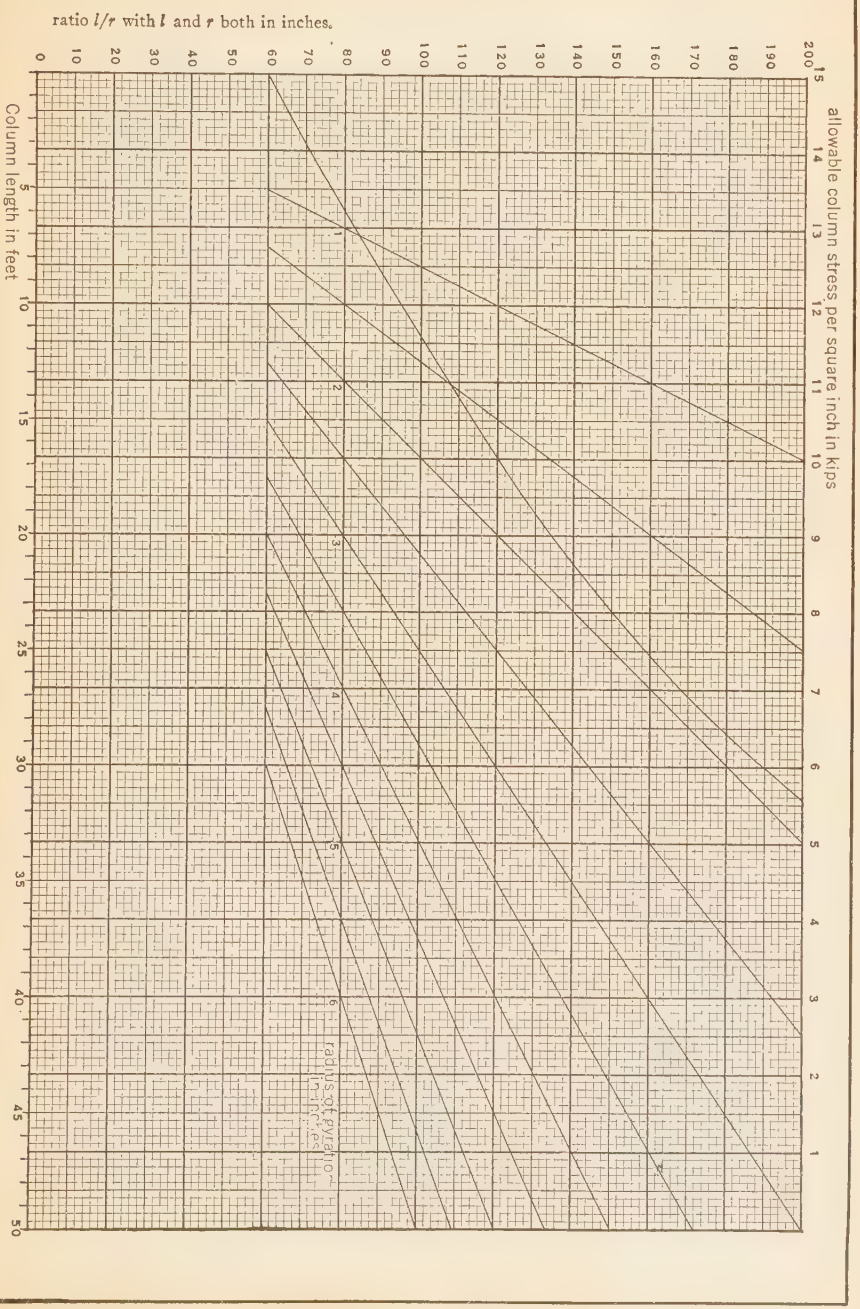
The oblique lines through the points on the scale of radius of gyration in inches all pass through zero. These lines intersect verticals from the base where the length of the column is shown in feet. The horizontal line at the point of this intersection gives the ratio of $l/r$ on the left of the chart. The line which is the scale of radius of gyration in inches is so located that the length of the column in feet is converted to inches and divided by the radius of gyration which is read on its scale. Where the horizontal line from the ratio of $l/r$ intersects the column formula curve, the allowable stress per square inch in the column is read at the top of the chart.

***Example:—***

The oblique line representing $r$ equal to 3 inches crosses the vertical line representing a column 27 feet long at a horizontal line showing the ratio $l/r$ to be 108. This horizontal line crosses the curve at a point which shows the stress to be 10,900 pounds per square inch.

A table giving the allowable working stress per square inch for ratios of $l/r$ ranging from 60 to 200 is given on the page immediately following the chart.

## COLUMNS


ratio $l/r$ with $l$ and $r$ both in inches.
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Column length in feet
5 10 15 20 25 30 35 40 45 50
allowable column stress per square inch in kips
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
1
2
3
4
5
6
radius of gyration in inches

# ALLOWABLE WORKING STRESS FOR COLUMNS. VARIOUS RATIOS $l/r$

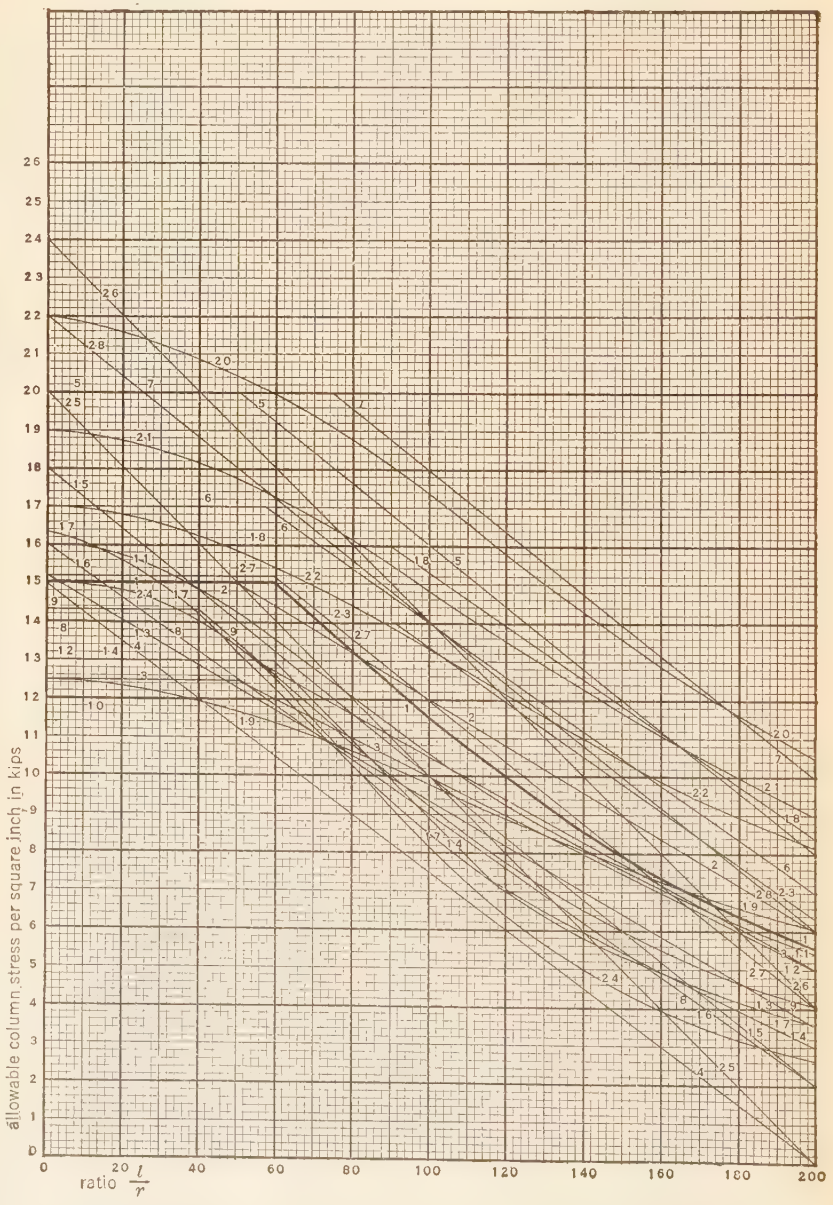
PRIMARY MEMBERS

| $l/r$ | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .0 | 15000 | 14916 | 14832 | 14748 | 14663 | 14578 | 14493 | 14407 | 14321 | 14235 | 14148 | 14062 | 13975 | 13888 | 13801 | 13714 | 13627 | 13540 | 13453 | 13366 |
| .1 | 14992 | 14908 | 14824 | 14740 | 14655 | 14570 | 14484 | 14398 | 14312 | 14226 | 14139 | 14053 | 13966 | 13879 | 13792 | 13705 | 13618 | 13531 | 13444 | 13357 |
| .2 | 14983 | 14899 | 14815 | 14731 | 14646 | 14561 | 14476 | 14390 | 14304 | 14218 | 14131 | 14045 | 13958 | 13871 | 13784 | 13697 | 13610 | 13523 | 13436 | 13349 |
| .3 | 14974 | 14891 | 14807 | 14723 | 14638 | 14553 | 14467 | 14381 | 14295 | 14209 | 14122 | 14036 | 13949 | 13862 | 13775 | 13688 | 13601 | 13514 | 13427 | 13340 |
| .4 | 14966 | 14882 | 14798 | 14714 | 14629 | 14544 | 14459 | 14373 | 14287 | 14200 | 14114 | 14027 | 13940 | 13853 | 13766 | 13679 | 13592 | 13505 | 13418 | 13331 |
| .5 | 14958 | 14874 | 14790 | 14706 | 14621 | 14536 | 14450 | 14364 | 14278 | 14192 | 14105 | 14019 | 13932 | 13845 | 13758 | 13671 | 13584 | 13497 | 13410 | 13323 |
| .6 | 14950 | 14866 | 14782 | 14697 | 14612 | 14527 | 14441 | 14355 | 14269 | 14183 | 14096 | 14010 | 13923 | 13836 | 13749 | 13662 | 13575 | 13488 | 13401 | 13314 |
| .7 | 14941 | 14857 | 14773 | 14689 | 14604 | 14519 | 14433 | 14347 | 14261 | 14174 | 14088 | 14001 | 13914 | 13827 | 13740 | 13653 | 13566 | 13479 | 13392 | 13305 |
| .8 | 14933 | 14849 | 14765 | 14680 | 14595 | 14510 | 14424 | 14338 | 14252 | 14165 | 14079 | 13992 | 13905 | 13818 | 13731 | 13644 | 13557 | 13470 | 13383 | 13296 |
| .9 | 14924 | 14840 | 14756 | 14672 | 14587 | 14502 | 14416 | 14330 | 14244 | 14157 | 14071 | 13984 | 13897 | 13810 | 13723 | 13636 | 13549 | 13462 | 13375 | 13288 |
| $l/r$ | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| .0 | 13279 | 13192 | 13105 | 13018 | 12931 | 12844 | 12758 | 12672 | 12585 | 12500 | 12414 | 12328 | 12243 | 12158 | 12073 | 11989 | 11905 | 11821 | 11737 | 11654 |
| .1 | 13270 | 13183 | 13096 | 13009 | 12922 | 12835 | 12749 | 12663 | 12577 | 12491 | 12405 | 12320 | 12235 | 12150 | 12065 | 11981 | 11897 | 11813 | 11729 | 11646 |
| .2 | 13262 | 13175 | 13088 | 13001 | 12914 | 12827 | 12741 | 12655 | 12568 | 12483 | 12397 | 12311 | 12226 | 12141 | 12056 | 11972 | 11888 | 11804 | 11720 | 11637 |
| .3 | 13253 | 13166 | 13079 | 12992 | 12905 | 12818 | 12732 | 12646 | 12560 | 12474 | 12388 | 12303 | 12218 | 12133 | 12048 | 11964 | 11880 | 11796 | 11712 | 11629 |
| .4 | 13244 | 13157 | 13070 | 12983 | 12896 | 12810 | 12724 | 12637 | 12551 | 12466 | 12380 | 12294 | 12209 | 12124 | 12039 | 11955 | 11871 | 11787 | 11704 | 11621 |
| .5 | 13236 | 13149 | 13062 | 12975 | 12888 | 12801 | 12715 | 12629 | 12543 | 12457 | 12371 | 12286 | 12201 | 12116 | 12031 | 11947 | 11863 | 11779 | 11696 | 11613 |
| .6 | 13227 | 13140 | 13053 | 12966 | 12879 | 12792 | 12706 | 12620 | 12534 | 12448 | 12362 | 12277 | 12192 | 12107 | 12023 | 11939 | 11855 | 11771 | 11687 | 11604 |
| .7 | 13218 | 13131 | 13044 | 12957 | 12870 | 12784 | 12698 | 12611 | 12526 | 12440 | 12354 | 12269 | 12184 | 12099 | 12014 | 11930 | 11846 | 11762 | 11679 | 11596 |
| .8 | 13209 | 13122 | 13035 | 12948 | 12861 | 12775 | 12689 | 12602 | 12517 | 12431 | 12345 | 12260 | 12175 | 12090 | 12006 | 11922 | 11838 | 11754 | 11671 | 11588 |
| .9 | 13201 | 13114 | 13027 | 12940 | 12853 | 12767 | 12681 | 12594 | 12509 | 12423 | 12337 | 12252 | 12167 | 12082 | 11997 | 11913 | 11829 | 11745 | 11662 | 11579 |
| $l/r$ | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 |
| .0 | 11571 | 11489 | 11407 | 11325 | 11244 | 11163 | 11082 | 11002 | 10922 | 10843 | 10764 | 10686 | 10608 | 10530 | 10453 | 10376 | 10300 | 10224 | 10149 | 10074 |
| .1 | 11563 | 11481 | 11399 | 11317 | 11236 | 11155 | 11074 | 10994 | 10914 | 10835 | 10756 | 10678 | 10600 | 10522 | 10445 | 10368 | 10292 | 10217 | 10142 | 10067 |
| .2 | 11555 | 11473 | 11391 | 11309 | 11228 | 11147 | 11066 | 10986 | 10906 | 10827 | 10748 | 10670 | 10592 | 10515 | 10438 | 10361 | 10285 | 10209 | 10134 | 10059 |
| .3 | 11546 | 11464 | 11382 | 11301 | 11220 | 11139 | 11058 | 10978 | 10898 | 10819 | 10741 | 10663 | 10585 | 10507 | 10430 | 10353 | 10277 | 10202 | 10127 | 10052 |
| .4 | 11538 | 11456 | 11374 | 11293 | 11212 | 11131 | 11050 | 10970 | 10890 | 10811 | 10733 | 10655 | 10577 | 10499 | 10422 | 10346 | 10270 | 10194 | 10119 | 10044 |
| .5 | 11530 | 11448 | 11366 | 11285 | 11204 | 11123 | 11042 | 10962 | 10883 | 10804 | 10725 | 10647 | 10569 | 10492 | 10415 | 10338 | 10262 | 10187 | 10112 | 10037 |
| .6 | 11522 | 11440 | 11358 | 11276 | 11195 | 11114 | 11034 | 10954 | 10875 | 10796 | 10717 | 10639 | 10561 | 10484 | 10407 | 10330 | 10254 | 10179 | 10104 | 10030 |
| .7 | 11514 | 11432 | 11350 | 11268 | 11187 | 11106 | 11026 | 10946 | 10867 | 10788 | 10709 | 10631 | 10553 | 10476 | 10399 | 10323 | 10247 | 10172 | 10097 | 10022 |
| .8 | 11505 | 11423 | 11341 | 11260 | 11179 | 11098 | 11018 | 10938 | 10859 | 10780 | 10702 | 10624 | 10546 | 10468 | 10391 | 10315 | 10239 | 10164 | 10089 | 10015 |
| .9 | 11497 | 11415 | 11333 | 11252 | 11171 | 11090 | 11010 | 10930 | 10851 | 10772 | 10694 | 10616 | 10538 | 10461 | 10384 | 10308 | 10232 | 10157 | 10082 | 10007 |
| $l/r$ | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 |
| .0 | 10000 | 9926 | 9853 | 9780 | 9708 | 9636 | 9565 | 9494 | 9424 | 9354 | 9284 | 9215 | 9146 | 9078 | 9011 | 8944 | 8878 | 8812 | 8747 | 8682 |
| .5 | 9963 | 9890 | 9817 | 9744 | 9672 | 9601 | 9530 | 9459 | 9389 | 9319 | 9250 | 9181 | 9112 | 9045 | 8978 | 8911 | 8845 | 8780 | 8715 | 8650 |
| $l/r$ | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 |
| .0 | 8617 | 8553 | 8489 | 8426 | 8364 | 8302 | 8241 | 8180 | 8120 | 8060 | 8000 | 7941 | 7882 | 7824 | 7767 | 7710 | 7653 | 7597 | 7541 | 7486 |
| .5 | 8583 | 8521 | 8458 | 8395 | 8333 | 8272 | 8211 | 8150 | 8090 | 8030 | 7971 | 7912 | 7853 | 7796 | 7739 | 7682 | 7625 | 7569 | 7514 | 7459 |
| $l/r$ | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 |
| .0 | 7431 | 7377 | 7323 | 7270 | 7217 | 7164 | 7112 | 7060 | 7009 | 6958 | 6908 | 6858 | 6808 | 6759 | 6711 | 6663 | 6615 | 6568 | 6521 | 6475 |
| .5 | 7404 | 7350 | 7297 | 7244 | 7191 | 7138 | 7086 | 7034 | 6984 | 6933 | 6883 | 6833 | 6784 | 6735 | 6687 | 6639 | 6592 | 6545 | 6498 | 6452 |
| $l/r$ | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 |
| .0 | 6429 | 6383 | 6338 | 6293 | 6248 | 6204 | 6160 | 6117 | 6074 | 6031 | 5989 | 5947 | 5905 | 5864 | 5823 | 5783 | 5743 | 5703 | 5664 | 5625 |
| .5 | 6406 | 6361 | 6316 | 6271 | 6226 | 6182 | 6139 | 6096 | 6053 | 6010 | 5968 | 5926 | 5885 | 5844 | 5803 | 5763 | 5723 | 5684 | 5645 | 5606 |

SECONDARY MEMBERS ONLY

ILLUSTRATION OF FLEXURE
AND
LOCAL CRIPPLING TYPES
OF
COLUMN FAILURES

## COLUMN DIAGRAMS



## COLUMN DIAGRAMS

On the page opposite there is a diagram illustrating twenty-eight (28) different column formulae, including that of the American Institute of Steel Construction which is shown as the heavy line.

Since the rolling mills began publishing handbooks about thirty-five years ago based on a 16,000 pound unit stress, an endless number of column formulae have been devised to give the allowable working stresses under different ratios of slenderness.

The diagrams clearly illustrate that the basic unit stress is not a consistent index of the so called factor of safety.

Below is given a key to the chart with the various formulae which are represented.

1. A. I. S. C.: 15000 to 60 $l/r$: beyond 60 $l/r = \dfrac{18{,}000}{1 + \dfrac{l^2}{18{,}000r^2}}$
2. Am. Bridge 1922: 18000— 60 $l/r$ with max. 15000
3. A. R. E. A. design Ry. Bridge: 15000—50 $l/r$ with max. 12500
4. A. R. E. A. electrical spec.: 15000—75 $l/r$
5. A. R. E. A. existing Ry. Bridge O. H. Steel: 24000—80 $l/r$ with max. 20000
6. A. R. E. A. existing Ry. Bridge Besm. Steel: 21000—70 $l/r$ with max. 17000
7. A. R. E. A. existing Buildings: 26000 — 80 $l/r$ with max. 20000
8. A. R. E. A. 1920 Ry. Bridges: 16000—70 $l/r$ with max. 14000
9. A. S. C. E. Highway Bridge: $\dfrac{16{,}000}{1 + \dfrac{l^2}{13{,}500r^2}}$ with max. at 40 $l/r$
10. Boston 1919: 12000 to 80 $l/r$: 20000—100 $l/r$ above 80 $l/r$
11. Boston 1918: $\dfrac{16{,}000}{1 + \dfrac{l^2}{20{,}000r^2}}$
12. Bethlehem Steel: 16000—55 $l/r$ with max. 13000
13. N. Y. City: 15200—58 $l/r$ prior to 1915. 16000—70 $l/r$
14. Carnegie straight lines: 13000 to 50 $l/r$: 7000 at 120 $l/r$: 3000 at 200 $l/r$
    J. & L. Chicago etc. use No. 8
15. Omaha: 18000—80 $l/r$
16. N. Y. C. Ry.: 16000—70 $l/r$ with max. 15000
    Can. Eng. Std. Assn. Ry. Bridges—Use No. 3
17. Philadelphia: $\dfrac{16{,}000}{1 + \dfrac{l^2}{11{,}000r^2}}$
18. Canton Boiler: 16000 to 90 $l/r$ above which 21400—60 $l/r$

19. Cambria-Gordon: $\dfrac{12{,}500}{1 + \dfrac{l^2}{36{,}000r^2}}$

20. Osborn Highway: $\dfrac{22{,}000}{1 + \dfrac{l^2}{36{,}000r^2}}$

21. Osborn Elect. Ry.: $\dfrac{19{,}000}{1 + \dfrac{l^2}{36{,}000r^2}}$

22. Osborn Steam Ry.: $\dfrac{17{,}000}{1 + \dfrac{l^2}{36{,}000r^2}}$

23. Chicago Bridge & Iron: 20300—70 $l/r$: max. 14000

24. Cleveland: $S = \dfrac{P}{A}\left[1 + \left(\dfrac{ec}{r^2} + \dfrac{3}{10}\right) \text{Sec.} \dfrac{l}{Kr}\sqrt{\dfrac{FP}{AE}}\right]$

25. Blackwells Island Bridge Ordinary loading: 20000—100 $l/r$

26. Blackwells Island Bridge Congested loading: 24000—100 $l/r$

27. Present Quebec Bridge combined loads exclusive of secondary stresses: 20000—80 $l/r$ with max. 15200

28. Present Quebec Bridge All combined loads inclusive of secondary stresses: 22000—80 $l/r$.

## RIVETS AND BOLTS

For many years there has been a considerable variation in the working stresses allowed in rivets, and careful thought was given this important subject. Engineers have long recognized that more complete conditions of bearing exist on plates and sections, which are enclosed on both sides, than can exist on outside plates or sections where the rivet acts as a cantilever. Rational provision is made for this in our Specification and it will permit a more consistent and economical development of stresses. Tests which have been recently made clearly indicate the truth of what many engineers have believed regarding the friction between riveted surfaces being greater than the usually allowed working stress in the rivets.

The Specification also properly classifies rivets as power or hand driven instead of field or shop driven.

Power driven rivets are those driven by pneumatic tools, whether in the shop or field. Hand driven rivets are those driven without the use of pneumatic equipment.

# CONNECTION ANGLES

The use of the Standard Web Connection Angle for supporting the end reactions of beams and girders is based on the assumption that the beam or girder has been proportioned, and will act as a simple beam. If uniformly loaded a simple beam has its maximum bending moment and deflection at the center of the span.

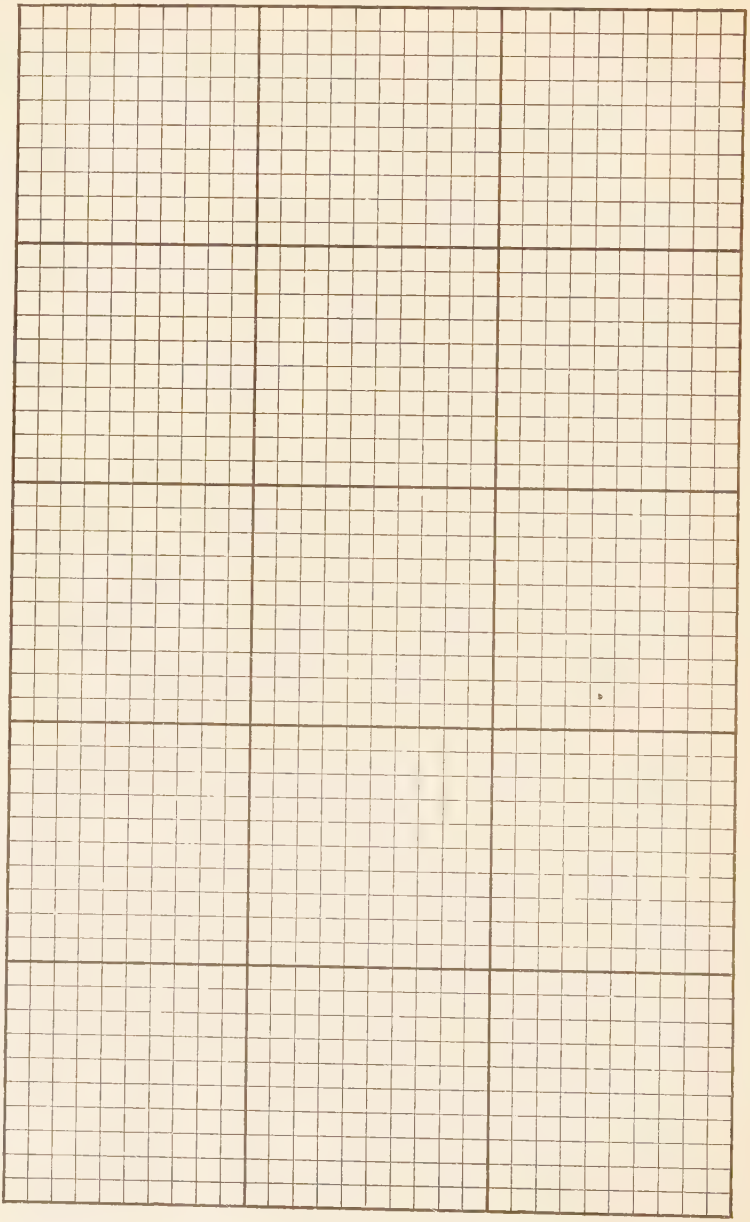
The deflection curve for a uniformly loaded simple span beam is a parabola, and where it supports a plastered ceiling the maximum deflection due to live load is limited to 1/360 of the span. The maximum bending moment of a uniformly loaded simple span beam occurs at the center. The maximum bending moment of a uniformly loaded fixed end beam occurs at the supports and is double the moment of the fixed end span at the center. For beams with the same loading and the same length of span the maximum bending moment of the fixed end beam is two-thirds of the maximum moment of the simple span beam. It is obviously impossible to consider a pair of web connection angles capable of changing the simple span beam to one with fixed ends. Where there is a deflection of 1/360 of the span due to uniform loading, the ends of the beam will no longer be perpendicular to the original axis of the beam, but will move through an angle of about 0° 38′, causing bending in the outstanding legs of the connection angles between the rivets and the heel of the angles. This movement in the outstanding legs of the angles will be the same for all thicknesses of angles so long as the beam acts as a simple span, and the unit stress resulting from this bending in the angles will be proportional to the thickness of the material which is bent. That is, the relative unit stresses in angles $\frac{3}{8}$″ thick and $\frac{1}{2}$″ thick is as 3 is to 4, and, for the same deflection, the unit stress in a $\frac{1}{2}$″ angle is 1.33 times the unit stress in a $\frac{3}{8}$″ angle.

The proper thickness for connection angles for simple spans is therefore the minimum which will develop the bearing value of the rivets used in shear. For $\frac{3}{4}$″ power driven rivets this thickness is between $\frac{5}{16}$″ and $\frac{3}{8}$″, and the $\frac{3}{8}$″ thickness is therefore used.

It has been the standard of the industry to keep the center to center distance between rivets in the outstanding angle legs $5\frac{1}{2}$″ by varying the gage in the outstanding legs of the angles to offset the different thickness of beam webs. This variation in the outstanding leg gage is by sixteenths of an inch, which is so inconspicuous in angles with equal legs that in shop assembling the web leg and the outstanding leg are often interchanged unless extreme care is used, resulting in errors which are expensive to correct in the field. To obviate this and speed up shop assembling, the standard connection is made 4″ × $3\frac{1}{2}$″ × $\frac{3}{8}$″ with the $3\frac{1}{2}$″ leg and a $2\frac{1}{4}$″ gage always on the beam web. The $2\frac{1}{4}$″ gage in the leg against the web is sufficient to permit ignoring the allowable cutting tolerance of $\frac{3}{8}$″ over or under the ordered length of the beam.

The 4″ × $3\frac{1}{2}$″ × $\frac{3}{8}$″ is a more desirable angle for stock as it is more adaptable to other uses than the 4″ × 4″ × $\frac{1}{2}$″ angle previously used.

## NOTES and DIAGRAMS



# Part IV
# Section 2

## Angles

Dimensions and Technical Functions

Tensile Values

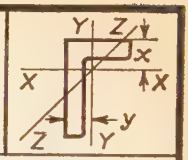
Allowable Total Loads
by
A. I. S. C. Specification
for
One Angle Struts

Two Angle Struts

Angles used as Beams

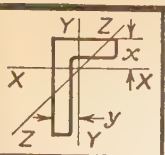
# STANDARD ANGLES

SIZES
WEIGHTS — AREAS
TECHNICAL FUNCTIONS




| Size in Inches | Thickness | Weight per Foot | Area in Sq. In. | AXES X-X I | X-X S | X-X r | X-X x | Y-Y I | Y-Y S | Y-Y r | Y-Y y | Z-Z r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ★ 1¾ × 1¾ | 1/8 | 1.44 | 0.42 | 0.13 | 0.10 | 0.55 | 0.48 | .... | .... | .... | .... | 0.35 |
| | 3/16 | 2.12 | 0.62 | 0.18 | 0.14 | 0.54 | 0.51 | .... | .... | .... | .... | 0.34 |
| | 1/4 | 2 77 | 0.81 | 0.23 | 0 19 | 0 53 | 0.53 | .... | .... | .... | .... | 0.34 |
| ★ 2 × 2 | 1/8 | 1.65 | 0 48 | 0.19 | 0 13 | 0.63 | 0 55 | .... | .... | .... | .... | 0.40 |
| | 3/16 | 2.44 | 0.72 | 0 27 | 0.19 | 0.62 | 0.57 | .... | .... | .... | .... | 0.39 |
| | 1/4 | 3.19 | 0.94 | 0.35 | 0.25 | 0.61 | 0.59 | .... | .... | .... | .... | 0.39 |
| | 5/16 | 3.92 | 1 15 | 0 42 | 0.30 | 0 60 | 0 61 | .... | .... | .... | .... | 0.39 |
| ★ 2½ × 2 | 1/8 | 1.86 | 0.55 | 0 35 | 0.20 | 0.80 | 0.74 | 0 20 | 0 13 | 0.61 | 0.49 | 0.43 |
| | 3/16 | 2.75 | 0.81 | 0.51 | 0.29 | 0.79 | 0.76 | 0.29 | 0 20 | 0.60 | 0.51 | 0.43 |
| | 1/4 | 3.62 | 1.06 | 0 65 | 0.38 | 0.78 | 0.79 | 0 37 | 0 25 | 0 59 | 0.54 | 0.42 |
| | 5/16 | 4 50 | 1 31 | 0 79 | 0.47 | 0.78 | 0.81 | 0.45 | 0 31 | 0.58 | 0.56 | 0.42 |
| ★ 2½ × 2½ | 1/8 | 2.08 | 0 61 | 0.38 | 0.20 | 0.79 | 0.67 | .... | .... | .... | .... | 0.50 |
| | 3/16 | 3.07 | 0.90 | 0.55 | 0 30 | 0 78 | 0.69 | .... | .... | .... | .... | 0.49 |
| | 1/4 | 4 1 | 1.19 | 0.70 | 0.39 | 0 77 | 0 72 | .... | .... | .... | .... | 0.49 |
| | 5/16 | 5.0 | 1 47 | 0.85 | 0.48 | 0 76 | 0 74 | .... | .... | .... | .... | 0.49 |
| | 3/8 | 5.9 | 1.73 | 0 98 | 0 57 | 0 75 | 0 76 | .... | .... | .... | .... | 0.48 |
| 3 × 2½ | 1/4 | 4.5 | 1.31 | 1.17 | 0.56 | 0.95 | 0 91 | 0.74 | 0 40 | 0 75 | 0.66 | 0.53 |
| | 5/16 | 5.6 | 1.62 | 1.42 | 0 69 | 0.94 | 0 93 | 0 90 | 0.49 | 0.74 | 0.68 | 0.53 |
| | 3/8 | 6.6 | 1.92 | 1.66 | 0.81 | 0 93 | 0 96 | 1 04 | 0 58 | 0.74 | 0.71 | 0.52 |
| | 7/16 | 7.6 | 2 22 | 1 88 | 0 93 | 0 92 | 0 98 | 1 18 | 0 66 | 0 73 | 0.73 | 0.52 |
| 3 × 3 | 1/4 | 4.9 | 1.44 | 1.24 | 0 58 | 0 93 | 0.84 | .... | .... | .... | .... | 0.59 |
| | 5/16 | 6 1 | 1.78 | 1 51 | 0.71 | 0 92 | 0 87 | .... | .... | .... | .... | 0.59 |
| | 3/8 | 7.2 | 2.11 | 1.76 | 0.83 | 0.91 | 0 89 | .... | .... | .... | .... | 0.58 |
| | 7/16 | 8.3 | 2.43 | 1.99 | 0 95 | 0.91 | 0.91 | .... | .... | .... | .... | 0 58 |
| | 1/2 | 9 4 | 2 75 | 2 22 | 1 07 | 0 90 | 0 93 | .... | .... | .... | .... | 0.58 |
| 3½ × 2½ | 1/4 | 4.9 | 1.44 | 1.80 | 0.75 | 1.12 | 1.11 | 0.78 | 0 41 | 0.74 | 0.61 | 0.54 |
| | 5/16 | 6.1 | 1.78 | 2.19 | 0.93 | 1.11 | 1.14 | 0.94 | 0 50 | 0.73 | 0 64 | 0.54 |
| | 3/8 | 7 2 | 2.11 | 2.56 | 1.09 | 1.10 | 1.16 | 1 09 | 0.59 | 0.72 | 0.66 | 0.54 |
| | 7/16 | 8 3 | 2.43 | 2 91 | 1.26 | 1 09 | 1.18 | 1.23 | 0 68 | 0.71 | 0 68 | 0 54 |
| | 1/2 | 9 4 | 2.75 | 3 24 | 1 41 | 1.09 | 1.20 | 1 36 | 0 76 | 0.70 | 0.70 | 0.53 |
| 3½ × 3½ | 5/16 | 7 2 | 2 09 | 2.45 | 0.98 | 1.08 | 0.99 | .... | .... | .... | .... | 0.69 |
| | 3/8 | 8.5 | 2 48 | 2.87 | 1.15 | 1.07 | 1.01 | .... | .... | .... | .... | 0.68 |
| | 7/16 | 9 8 | 2 87 | 3.26 | 1.32 | 1.07 | 1.04 | .... | .... | .... | .... | 0.68 |
| | 1/2 | 11.1 | 3 25 | 3 64 | 1.49 | 1.06 | 1.06 | .... | .... | .... | .... | 0.68 |
| | 9/16 | 12.4 | 3.62 | 3.99 | 1.65 | 1.05 | 1.08 | .... | .... | .... | .... | 0.68 |
| | 5/8 | 13.6 | 3 98 | 4 33 | 1.81 | 1.04 | 1 10 | .... | .... | .... | .... | 0.68 |
| 4 × 3 | 5/16 | 7.2 | 2.09 | 3 38 | 1.23 | 1.27 | 1.26 | 1.65 | 0.73 | 0.89 | 0.76 | 0.65 |
| | 3/8 | 8 5 | 2 48 | 3.96 | 1.46 | 1.26 | 1.28 | 1 92 | 0 87 | 0.88 | 0.78 | 0.64 |
| | 7/16 | 9 8 | 2.87 | 4 52 | 1.68 | 1 25 | 1.30 | 2 18 | 0.99 | 0 87 | 0.80 | 0.64 |
| | 1/2 | 11 1 | 3 25 | 5 05 | 1 89 | 1.25 | 1 33 | 2 42 | 1.12 | 0.86 | 0.83 | 0.64 |
| | 9/16 | 12.4 | 3.62 | 5.55 | 2.09 | 1.24 | 1.35 | 2.66 | 1.23 | 0.86 | 0.85 | 0.64 |
| | 5/8 | 13 6 | 3 98 | 6 03 | 2 30 | 1 23 | 1.37 | 2.87 | 1 35 | 0.85 | 0 87 | 0.64 |
| 4 × 3½ | 5/16 | 7.7 | 2 25 | 3.56 | 1 26 | 1.26 | 1.18 | 2.55 | 0.99 | 1.07 | 0.93 | 0.73 |
| | 3/8 | 9.1 | 2 67 | 4 18 | 1.49 | 1.25 | 1.21 | 2.99 | 1.17 | 1.06 | 0.96 | 0.73 |
| | 7/16 | 10 6 | 3 09 | 4.76 | 1.72 | 1.24 | 1.23 | 3.40 | 1.35 | 1.05 | 0.98 | 0.72 |
| | 1/2 | 11 9 | 3 50 | 5 32 | 1 94 | 1 23 | 1.25 | 3.79 | 1 52 | 1.04 | 1.00 | 0.72 |
| | 9/16 | 13 3 | 3.90 | 5 86 | 2.15 | 1 23 | 1.27 | 4.17 | 1.68 | 1.03 | 1.02 | 0.72 |
| | 5/8 | 14 7 | 4 30 | 6 37 | 2 35 | 1.22 | 1.29 | 4.49 | 1.83 | 1.02 | 1.04 | 0.72 |
| | 11/16 | 16 0 | 4.68 | 6 86 | 2.56 | 1.21 | 1.32 | 4.86 | 2 00 | 1.02 | 1.07 | 0.72 |
| | 3/4 | 17 3 | 5 06 | 7 32 | 2 75 | 1.20 | 1 34 | 5 18 | 2 15 | 1 01 | 1.09 | 0.72 |
| 4 × 4 | 5/16 | 8 2 | 2.40 | 3.71 | 1.29 | 1.24 | 1.12 | .... | .... | .... | .... | 0.79 |
| | 3/8 | 9 8 | 2.86 | 4 36 | 1.52 | 1.23 | 1.14 | .... | .... | .... | .... | 0.79 |
| | 7/16 | 11.3 | 3.31 | 4.97 | 1.75 | 1.23 | 1.16 | .... | .... | .... | .... | 0.78 |
| | 1/2 | 12 8 | 3 75 | 5 56 | 1 97 | 1.22 | 1.18 | .... | .... | .... | .... | 0.78 |
| | 9/16 | 14 3 | 4 18 | 6 12 | 2.19 | 1 21 | 1.21 | .... | .... | .... | .... | 0.78 |
| | 5/8 | 15 7 | 4.61 | 6 66 | 2 40 | 1 20 | 1.23 | .... | .... | .... | .... | 0.77 |
| | 11/16 | 17 1 | 5.03 | 7.17 | 2 61 | 1.19 | 1.25 | .... | .... | .... | .... | 0.77 |
| | 3/4 | 18 5 | 5 44 | 7 66 | 2 81 | 1.19 | 1 27 | .... | .... | .... | .... | 0.77 |
| 5 × 3 | 5/16 | 8 2 | 2 40 | 6 26 | 1 89 | 1.61 | 1.68 | 1.75 | 0.75 | 0.85 | 0.68 | 0.66 |
| | 3/8 | 9 8 | 2 86 | 7.37 | 2 24 | 1.61 | 1.70 | 2.04 | 0.89 | 0.84 | 0.70 | 0.65 |
| | 7/16 | 11.3 | 3 31 | 8.43 | 2.58 | 1.60 | 1.73 | 2.32 | 1.02 | 0.84 | 0.73 | 0.65 |
| | 1/2 | 12 8 | 3.75 | 9 45 | 2 91 | 1 59 | 1 75 | 2.58 | 1.15 | 0.83 | 0.75 | 0.65 |
| | 9/16 | 14.3 | 4.18 | 10 43 | 3.23 | 1.58 | 1.77 | 2.83 | 1.27 | 0.82 | 0.77 | 0.65 |
| | 5/8 | 15 7 | 4 61 | 11 37 | 3.55 | 1.57 | 1.80 | 3.06 | 1.39 | 0.82 | 0.80 | 0.64 |
| | 11/16 | 17.1 | 5.03 | 12.28 | 3 86 | 1.56 | 1.82 | 3.29 | 1.51 | 0.81 | 0.82 | 0.64 |
| | 3/4 | 18 5 | 5.44 | 13 15 | 4.16 | 1.55 | 1.84 | 3.51 | 1.62 | 0.80 | 0.84 | 0.64 |

★ Angles are classified as in BAR SIZE when their greatest dimension is less than 3 inches.




# STANDARD ANGLES

SIZES
WEIGHTS — AREAS
TECHNICAL FUNCTIONS

| Size in Inches | Thickness | Weight per Foot | Area in Sq. In. | AXES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | X - X | | | | Y - Y | | | | Z - Z |
| | | | | I | S | r | x | I | S | r | y | r |
| 5 × 3½ | 5/16 | 8 7 | 2 56 | 6 60 | 1 94 | 1 61 | 1 59 | 2 72 | 1 02 | 1.03 | 0 84 | 0.77 |
| | 3/8 | 10.4 | 3 05 | 7 78 | 2 29 | 1 60 | 1.61 | 3 18 | 1 21 | 1 02 | 0 86 | 0.76 |
| | 7/16 | 12 0 | 3 53 | 8 90 | 2 64 | 1 59 | 1 63 | 3 63 | 1 39 | 1 01 | 0 88 | 0.76 |
| | 1/2 | 13 6 | 4.00 | 9 99 | 2 99 | 1 58 | 1 66 | 4.05 | 1 56 | 1.01 | 0 91 | 0 75 |
| | 9/16 | 15 2 | 4 47 | 11 03 | 3.32 | 1 57 | 1 68 | 4 45 | 1 73 | 1.00 | 0 93 | 0 75 |
| | 5/8 | 16.8 | 4 92 | 12 03 | 3.65 | 1.56 | 1 70 | 4.83 | 1 90 | 0.99 | 0.95 | 0.75 |
| | 11/16 | 18 3 | 5.37 | 12 99 | 3 97 | 1 56 | 1 72 | 5 20 | 2.06 | 0.98 | 0.97 | 0.75 |
| | 3/4 | 19 8 | 5 81 | 13.92 | 4 28 | 1 55 | 1 75 | 5 55 | 2 22 | 0 98 | 1 00 | 0.75 |
| 6 × 3½ | 3/8 | 11 7 | 3 42 | 12 86 | 3 24 | 1 94 | 2 04 | 3.34 | 1 23 | 0.99 | 0.79 | 0.77 |
| | 7/16 | 13.5 | 3 97 | 14 76 | 3 75 | 1 93 | 2 06 | 3.81 | 1.41 | 0.98 | 0.81 | 0.76 |
| | 1/2 | 15 3 | 4.50 | 16 59 | 4.24 | 1 92 | 2 08 | 4.25 | 1.59 | 0 97 | 0 83 | 0.76 |
| | 9/16 | 17.1 | 5 03 | 18.37 | 4 72 | 1 91 | 2 11 | 4 67 | 1.77 | 0 96 | 0 86 | 0.75 |
| | 5/8 | 18 9 | 5 55 | 20 08 | 5 19 | 1.90 | 2 13 | 5.08 | 1.94 | 0 96 | 0 88 | 0.75 |
| | 11/16 | 20 6 | 6 06 | 21.74 | 5.65 | 1 89 | 2 15 | 5.47 | 2.11 | 0 95 | 0.90 | 0.75 |
| | 3/4 | 22.4 | 6 56 | 23.34 | 6 10 | 1 89 | 2 18 | 5.84 | 2.27 | 0.94 | 0.93 | 0.75 |
| | 13/16 | 24 0 | 7 06 | 24 89 | 6 55 | 1 88 | 2 20 | 6 20 | 2.43 | 0 94 | 0.95 | 0.75 |
| | 7/8 | 25 7 | 7 55 | 26 39 | 6 98 | 1 87 | 2 22 | 6 55 | 2 59 | 0.93 | 0 97 | 0.75 |
| 6 × 4 | 3/8 | 12 3 | 3 61 | 13 47 | 3.32 | 1.93 | 1 94 | 4 90 | 1.60 | 1.17 | 0 94 | 0.88 |
| | 7/16 | 14 3 | 4.18 | 15 46 | 3.83 | 1 92 | 1.96 | 5.60 | 1 85 | 1.16 | 0.96 | 0.87 |
| | 1/2 | 16 2 | 4 75 | 17 40 | 4.33 | 1 91 | 1 99 | 6 27 | 2 08 | 1 15 | 0 99 | 0 87 |
| | 9/16 | 18 1 | 5 31 | 19 26 | 4 83 | 1 90 | 2 01 | 6 91 | 2 31 | 1 14 | 1 01 | 0 87 |
| | 5/8 | 20 0 | 5 86 | 21 07 | 5 31 | 1 90 | 2 03 | 7 52 | 2 54 | 1 13 | 1 03 | 0 86 |
| | 11/16 | 21 8 | 6 40 | 22 82 | 5 78 | 1 89 | 2 06 | 8 11 | 2 76 | 1 13 | 1 06 | 0 86 |
| | 3/4 | 23 6 | 6 94 | 24.51 | 6 25 | 1 88 | 2 08 | 8 68 | 2 97 | 1 12 | 1 08 | 0.86 |
| | 13/16 | 25 4 | 7 47 | 26 15 | 6 70 | 1 87 | 2 10 | 9 23 | 3 18 | 1 11 | 1 10 | 0.86 |
| | 7/8 | 27 2 | 7 98 | 27 73 | 7 15 | 1 86 | 2 12 | 9 75 | 3 39 | 1 11 | 1 12 | 0 86 |
| 6 × 6 | 3/8 | 14 9 | 4.36 | 15 39 | 3 53 | 1 88 | 1 64 | .. | .... | ... | .. | 1.19 |
| | 7/16 | 17 2 | 5.06 | 17 68 | 4 07 | 1 87 | 1 66 | .. | .. .. | ... | ... | 1.19 |
| | 1/2 | 19 6 | 5.75 | 19 91 | 4 61 | 1 86 | 1 68 | .... | .... | ... | .... | 1.18 |
| | 9/16 | 21 9 | 6.43 | 22 07 | 5 14 | 1 85 | 1 71 | .. | .... | .... | .... | 1 18 |
| | 5/8 | 24 2 | 7.11 | 24 16 | 5 66 | 1 84 | 1 73 | .. | .. .. | ... | ... | 1 17 |
| | 11/16 | 26 5 | 7.78 | 26 19 | 6 17 | 1 83 | 1 75 | .. .. | .. | .. | ... | 1.17 |
| | 3/4 | 28 7 | 8.44 | 28 15 | 6 66 | 1 83 | 1 78 | .. .. | .. | .... | .... | 1.17 |
| | 13/16 | 31 0 | 9.09 | 30 06 | 7 15 | 1 82 | 1 80 | .... | .... | .... | .. .. | 1 17 |
| | 7/8 | 33 1 | 9.73 | 31 92 | 7 63 | 1 81 | 1 82 | .... | .... | .. | .... | 1.16 |
| | 15/16 | 35 3 | 10.37 | 33 72 | 8 11 | 1 80 | 1 84 | .. | .... | .... | .... | 1 16 |
| | 1 | 37 4 | 11.00 | 35 46 | 8 57 | 1 80 | 1 86 | .. .. | .. | | | 1 16 |
| 7 × 3½ | 3/8 | 13 0 | 3 80 | 19 62 | 4 34 | 2 27 | 2 48 | 3 47 | 1 25 | 0 96 | 0 73 | 0 76 |
| | 7/16 | 15 0 | 4 40 | 22 56 | 5 01 | 2 26 | 2 50 | 3 95 | 1 44 | 0 95 | 0 75 | 0 76 |
| | 1/2 | 17 0 | 5 00 | 25 41 | 5 68 | 2 25 | 2 53 | 4 41 | 1 62 | 0 94 | 0 78 | 0 75 |
| | 9/16 | 19 1 | 5 59 | 28 18 | 6 31 | 2 25 | 2 55 | 4 86 | 1 80 | 0 93 | 0 80 | 0 75 |
| | 5/8 | 21 0 | 6 17 | 30 86 | 6 96 | 2 24 | 2 57 | 5 28 | 1 97 | 0 93 | 0 82 | 0 75 |
| | 11/16 | 23 0 | 6 75 | 33 47 | 7 60 | 2 23 | 2 60 | 5 69 | 2 14 | 0 92 | 0 85 | 0 74 |
| | 3/4 | 24 9 | 7 31 | 35 99 | 8 22 | 2 22 | 2 62 | 6 08 | 2 31 | 0 91 | 0 87 | 0 74 |
| | 13/16 | 26 8 | 7 87 | 38 45 | 8 83 | 2 21 | 2 64 | 6 46 | 2 48 | 0 91 | 0 89 | 0 74 |
| | 7/8 | 28 7 | 8 42 | 40 82 | 9 42 | 2 20 | 2 66 | 6 83 | 2 64 | 0 90 | 0 91 | 0 74 |
| | 15/16 | 30 5 | 8 97 | 43 13 | 10 00 | 2 19 | 2 69 | 7 18 | 2 80 | 0 89 | 0 94 | 0 74 |
| | 1 | 32 3 | 9 50 | 45 37 | 10 58 | 2 19 | 2 71 | 7 53 | 2 96 | 0 89 | 0 96 | 0 74 |
| 8 × 6 | 7/16 | 20 2 | 5 93 | 39 23 | 7 07 | 2 57 | 2 45 | 19 25 | 4 23 | 1 80 | 1 45 | 1 30 |
| | 1/2 | 23 0 | 6 75 | 44 31 | 8 02 | 2 56 | 2 47 | 21 68 | 4 79 | 1 79 | 1 47 | 1.30 |
| | 9/16 | 25 7 | 7 56 | 49 26 | 8 95 | 2 55 | 2 50 | 24 04 | 5 34 | 1 78 | 1 50 | 1 30 |
| | 5/8 | 28 5 | 8 36 | 54 10 | 9 87 | 2 54 | 2 52 | 26 33 | 5 88 | 1 77 | 1 52 | 1.29 |
| | 11/16 | 31 2 | 9 15 | 58 82 | 10 77 | 2 54 | 2 54 | 28 56 | 6 40 | 1 77 | 1 54 | 1 29 |
| | 3/4 | 33 8 | 9 94 | 63 42 | 11 67 | 2 53 | 2 56 | 30 72 | 6 92 | 1 76 | 1 56 | 1.28 |
| | 13/16 | 36 5 | 10 72 | 67 92 | 12 55 | 2 52 | 2 59 | 32 82 | 7 44 | 1 75 | 1 59 | 1.28 |
| | 7/8 | 39 1 | 11 48 | 72 32 | 13 41 | 2 51 | 2 61 | 34 86 | 7 94 | 1.74 | 1 61 | 1.28 |
| | 15/16 | 41 7 | 12 25 | 76 59 | 14 27 | 2 50 | 2.63 | 36 85 | 8 43 | 1.73 | 1 63 | 1.28 |
| | 1 | 44 2 | 13 00 | 80 78 | 15 11 | 2 49 | 2 65 | 38 78 | 8 92 | 1 73 | 1 65 | 1 28 |
| 8 × 8 | 1/2 | 26 4 | 7 75 | 48 65 | 8 37 | 2 51 | 2 19 | .... | .... | .... | .... | 1.59 |
| | 9/16 | 29 6 | 8 68 | 54 09 | 9 34 | 2 50 | 2.21 | .... | .... | .... | .... | 1.58 |
| | 5/8 | 32 7 | 9 61 | 59 43 | 10 30 | 2 49 | 2 23 | .... | .... | .... | .... | 1.58 |
| | 11/16 | 35 8 | 10 53 | 64 64 | 11 25 | 2 48 | 2 25 | .... | .... | .... | .... | 1.58 |
| | 3/4 | 38 9 | 11 44 | 69 74 | 12 18 | 2 47 | 2 28 | .... | .... | .... | .... | 1 57 |
| | 13/16 | 42 0 | 12 34 | 74 72 | 13 11 | 2 46 | 2 30 | .... | .... | .... | .... | 1.57 |
| | 7/8 | 45 0 | 13 23 | 79 58 | 14 02 | 2.45 | 2.32 | .... | .... | .... | .... | 1.56 |
| | 15/16 | 48 1 | 14 12 | 84 34 | 14 91 | 2.44 | 2 34 | .... | .... | .... | .... | 1.56 |
| | 1 | 51 0 | 15 00 | 88 98 | 15.80 | 2.44 | 2.37 | .... | .... | .... | .. | 1.56 |
| | 1 1/16 | 54 0 | 15.87 | 93 53 | 16.67 | 2.43 | 2.39 | .... | .... | .... | .... | 1.56 |
| | 1 1/8 | 56 9 | 16 73 | 97 97 | 17.53 | 2 42 | 2.41 | .... | .... | .... | .... | 1 55 |

# STANDARD ANGLES

NET AREAS AND TENSILE VALUES OF ONE ANGLE IN KIPS

TENSION AT 18000 POUNDS PER SQUARE INCH

TO DEVELOP VALUES BELOW, ANGLES MUST BE ATTACHED BY BOTH LEGS

| Size in Inches | Thickness | ½″ RIVET | | ⅝″ RIVET | | ¾″ RIVET | | | | ⅞″ RIVET | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 HOLE OUT | | 1 HOLE OUT | | 1 HOLE OUT | | 2 HOLES OUT | | 1 HOLE OUT | | 2 HOLES OUT | |
| | | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value |
| ★ 1¾ × 1¾ | ⅛ | .342 | 6.16 | | | | | | | | | | |
| | 3/16 | .503 | 9.05 | | | | | | | | | | |
| | ¼ | .654 | 11.77 | | | | | | | | | | |
| ★ 2 × 2 | ⅛ | .402 | 7.24 | .386 | 6.95 | | | | | | | | |
| | 3/16 | .593 | 10.67 | .569 | 10.24 | | | | | | | | |
| | ¼ | .784 | 14.11 | .752 | 13.54 | | | | | | | | |
| | 5/16 | .955 | 17.19 | .916 | 16 49 | | | | | | | | |
| ★ 2½ × 2 | ⅛ | .472 | 8.50 | .456 | 8.21 | | | | | | | | |
| | 3/16 | .693 | 12.47 | .669 | 12.04 | .646 | 11.63 | | | | | | |
| | ¼ | .904 | 16 27 | .872 | 15.70 | .841 | 15.14 | | | | | | |
| | 5/16 | 1.115 | 20 07 | 1.076 | 19 37 | 1.037 | 18.66 | | | | | | |
| ★ 2½ × 2½ | ⅛ | .532 | 9 58 | .516 | 9.29 | | | | | | | | |
| | 3/16 | .783 | 14.09 | .759 | 13.66 | .736 | 13.25 | .572 | 10 30 | | | | |
| | ¼ | 1.034 | 18.61 | 1.002 | 18.04 | .971 | 17.48 | .752 | 13.54 | | | | |
| | 5/16 | 1.275 | 22 95 | 1.236 | 22.25 | 1 197 | 21.55 | .924 | 16 63 | | | | |
| | ⅜ | 1.496 | 26.93 | 1.448 | 26.06 | 1 402 | 25 24 | 1.074 | 19 33 | | | | |
| 3 × 2½ | ¼ | 1.154 | 20.77 | 1.122 | 20 20 | 1 091 | 19.64 | .872 | 15 70 | | | | |
| | 5/16 | 1.425 | 25 65 | 1.386 | 24.95 | 1 347 | 24.25 | 1.074 | 19 33 | | | | |
| | ⅜ | 1.686 | 30.35 | 1.638 | 29 48 | 1 592 | 28.66 | 1 264 | 22.75 | | | | |
| | 7/16 | 1.937 | 34.87 | 1.882 | 33 88 | 1.827 | 32 89 | 1 444 | 25 99 | | | | |
| 3 × 3 | ¼ | ..... | ..... | 1.252 | 22.54 | 1 221 | 21 98 | 1.002 | 18 04 | | | | |
| | 5/16 | ..... | ..... | 1.546 | 27.83 | 1.507 | 27.13 | 1.234 | 22 21 | | | | |
| | ⅜ | ..... | ..... | 1 828 | 32.90 | 1.782 | 32 08 | 1.454 | 26.17 | | | | |
| | 7/16 | ..... | ..... | 2 102 | 37.84 | 2.047 | 36.85 | 1 664 | 29.95 | | | | |
| | ½ | ..... | ..... | 2.375 | 42 75 | 2 312 | 41 62 | 1 875 | 33.75 | | | | |
| 3½ × 2½ | ¼ | ..... | ..... | 1.252 | 22.54 | 1.221 | 21.98 | 1.002 | 18.04 | | | | |
| | 5/16 | ..... | ..... | 1 546 | 27.83 | 1.507 | 27 13 | 1.234 | 22 21 | | | | |
| | ⅜ | ..... | ..... | 1.828 | 32 90 | 1 782 | 32.08 | 1.454 | 26.17 | | | | |
| | 7/16 | ..... | ..... | 2.102 | 37.84 | 2 047 | 36.85 | 1.664 | 29 95 | | | | |
| | ½ | ..... | ..... | 2 375 | 42 75 | 2 312 | 41.62 | 1.875 | 33.75 | | | | |
| 3½ × 3½ | 5/16 | ..... | ..... | ..... | ..... | 1.817 | 32.71 | 1.544 | 27.79 | 1.777 | 31.99 | 1 466 | 26.39 |
| | ⅜ | ..... | ..... | ..... | ..... | 2.152 | 38.74 | 1.824 | 32 83 | 2 105 | 37.89 | 1.730 | 31.14 |
| | 7/16 | ..... | ..... | ..... | ..... | 2.487 | 44.77 | 2 104 | 37 87 | 2.432 | 43.78 | 1.994 | 35.89 |
| | ½ | ..... | ..... | ..... | ..... | 2 812 | 50 62 | 2 375 | 42.75 | 2.750 | 49.50 | 2.250 | 40.50 |
| | 9/16 | ..... | ..... | ..... | ..... | 3.128 | 56 30 | 2 636 | 47 45 | 3 057 | 55 03 | 2.494 | 44.89 |
| | ⅝ | ..... | ..... | ..... | ..... | 3 433 | 61.79 | 2.886 | 51.95 | 3 355 | 60.39 | 2.730 | 49 14 |
| 4 × 3 | 5/16 | ..... | ..... | ..... | ..... | 1.817 | 32.71 | 1 544 | 27.79 | 1.777 | 31.99 | 1.466 | 26.39 |
| | ⅜ | ..... | ..... | ..... | ..... | 2 152 | 38.74 | 1.824 | 32 83 | 2.105 | 37.89 | 1.730 | 31.14 |
| | 7/16 | ..... | ..... | ..... | ..... | 2 487 | 44.77 | 2 104 | 37 87 | 2.432 | 43 78 | 1.994 | 35.89 |
| | ½ | ..... | ..... | ..... | ..... | 2 812 | 50.62 | 2 375 | 42 75 | 2 750 | 49.50 | 2 250 | 40.50 |
| | 9/16 | ..... | ..... | ..... | ..... | 3 128 | 56 30 | 2.636 | 47 45 | 3 057 | 55.03 | 2.494 | 44.89 |
| | ⅝ | ..... | ..... | ..... | ..... | 3 433 | 61 79 | 2.886 | 51 95 | 3 355 | 60.39 | 2 730 | 49.14 |
| 4 × 3½ | 5/16 | ..... | ..... | ..... | ..... | 1 977 | 35 59 | 1.704 | 30 67 | 1 938 | 34 88 | 1 626 | 29.27 |
| | ⅜ | ..... | ..... | ..... | ..... | 2.342 | 42 16 | 2.014 | 36 25 | 2 295 | 41.31 | 1.920 | 34 56 |
| | 7/16 | ..... | ..... | ..... | ..... | 2 707 | 48 73 | 2 324 | 41.83 | 2 652 | 47.74 | 2 214 | 39.85 |
| | ½ | ..... | ..... | ..... | ..... | 3 062 | 55.12 | 2 624 | 47 23 | 3 000 | 54.00 | 2.500 | 45 00 |
| | 9/16 | ..... | ..... | ..... | ..... | 3 408 | 61.34 | 2.916 | 52 49 | 3 337 | 60 07 | 2.774 | 49.93 |
| | ⅝ | ..... | ..... | ..... | ..... | 3 753 | 67.55 | 3.206 | 57 71 | 3.675 | 66.15 | 3.050 | 54 90 |
| | 11/16 | ..... | ..... | ..... | ..... | 4 078 | 73 40 | 3 476 | 62 57 | 3 992 | 71 86 | 3.304 | 59.47 |
| | ¾ | ..... | ..... | ..... | ..... | 4 404 | 79 27 | 3 748 | 67 46 | 4 310 | 77.58 | 3.560 | 64.08 |
| 4 × 4 | 5/16 | ..... | ..... | ..... | ..... | 2 127 | 38 29 | 1 854 | 33 37 | 2.087 | 37.57 | 1.774 | 31.93 |
| | ⅜ | ..... | ..... | ..... | ..... | 2 532 | 45 58 | 2 204 | 39 67 | 2 485 | 44.73 | 2 110 | 37.98 |
| | 7/16 | ..... | ..... | ..... | ..... | 2 927 | 52.69 | 2.544 | 45 79 | 2 872 | 51.70 | 2.434 | 43.81 |
| | ½ | ..... | ..... | ..... | ..... | 3 312 | 59 62 | 2 874 | 51.73 | 3.250 | 58 50 | 2.750 | 49.50 |
| | 9/16 | ..... | ..... | ..... | ..... | 3 688 | 66.38 | 3.196 | 57.53 | 3 617 | 65 11 | 3 054 | 54.97 |
| | ⅝ | ..... | ..... | ..... | ..... | 4 063 | 73.13 | 3.516 | 63.29 | 3.985 | 71.73 | 3 360 | 60 48 |
| | 11/16 | ..... | ..... | ..... | ..... | 4.428 | 79.70 | 3.826 | 68 87 | 4 342 | 78.16 | 3.654 | 65.77 |
| | ¾ | ..... | ..... | ..... | ..... | 4.784 | 86 11 | 4.128 | 74 30 | 4 690 | 84 42 | 3 940 | 70 92 |
| 5 × 3 | 5/16 | ..... | ..... | ..... | ..... | 2 127 | 38.29 | 1.854 | 33.37 | 2 087 | 37.57 | 1 775 | 31.95 |
| | ⅜ | ..... | ..... | ..... | ..... | 2.532 | 45.58 | 2.204 | 39 67 | 2.485 | 44.73 | 2.110 | 37.98 |
| | 7/16 | ..... | ..... | ..... | ..... | 2 927 | 52 69 | 2.544 | 45.79 | 2.872 | 51.70 | 2.435 | 43 83 |
| | ½ | ..... | ..... | ..... | ..... | 3.312 | 59 62 | 2.874 | 51.73 | 3 250 | 58.50 | 2.750 | 49 50 |
| | 9/16 | ..... | ..... | ..... | ..... | 3.688 | 66.38 | 3.196 | 57.53 | 3.617 | 65.11 | 3.055 | 54.99 |
| | ⅝ | ..... | ..... | ..... | ..... | 4.063 | 73.13 | 3.516 | 63.29 | 3.985 | 71.73 | 3.360 | 60.48 |
| | 11/16 | ..... | ..... | ..... | ..... | 4 428 | 79.70 | 3.826 | 68.87 | 4.342 | 78.16 | 3.655 | 65.79 |
| | ¾ | ..... | ..... | ..... | ..... | 4 784 | 86.11 | 4.128 | 74.30 | 4.690 | 84.42 | 3.940 | 70.92 |

★Angles are classified as in Bar Size when their greatest dimension is less than 3 inches.

**NET AREAS AND TENSILE VALUES OF ONE ANGLE IN KIPS**

**TENSION AT 18000 POUNDS PER SQUARE INCH**

**TO DEVELOP VALUES BELOW, ANGLES MUST BE ATTACHED BY BOTH LEGS**

# STANDARD ANGLES

| Size in Inches | Thickness | ¾″ RIVET | | | | ⅞″ RIVET | | | | 1″ RIVET | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 HOLE OUT | | 2 HOLES OUT | | 1 HOLE OUT | | 2 HOLES OUT | | 1 HOLE OUT | | 2 HOLES OUT | |
| | | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value | Net Area | Tens. Value |
| 5 × 3½ | 5/16 | 2.287 | 41.17 | 2.014 | 36.25 | 2.248 | 40.46 | 1.936 | 34.85 | | | | |
| | 3/8 | 2.722 | 49.00 | 2.394 | 43.09 | 2.675 | 48.15 | 2.300 | 41.40 | | | | |
| | 7/16 | 3.147 | 56.65 | 2.764 | 49.75 | 3.092 | 55.66 | 2.654 | 47.77 | | | | |
| | 1/2 | 3.562 | 64.12 | 3.124 | 56.23 | 3.500 | 63.00 | 3.000 | 54.00 | | | | |
| | 9/16 | 3.978 | 71.60 | 3.486 | 62.75 | 3.907 | 70.33 | 3.344 | 60.19 | | | | |
| | 5/8 | 4.373 | 78.71 | 3.826 | 68.87 | 4.295 | 77.31 | 3.670 | 66.06 | | | | |
| | 11/16 | 4.768 | 85.82 | 4.166 | 74.99 | 4.682 | 84.28 | 3.994 | 71.89 | | | | |
| | 3/4 | 5.154 | 92.77 | 4.498 | 80.96 | 5.060 | 91.08 | 4.310 | 77.58 | | | | |
| 6 × 3½ | 3/8 | 3.092 | 55.66 | 2.764 | 49.75 | 3.045 | 54.81 | 2.670 | 48.06 | | | | |
| | 7/16 | 3.587 | 64.57 | 3.204 | 57.67 | 3.532 | 63.58 | 3.095 | 55.71 | | | | |
| | 1/2 | 4.062 | 73.12 | 3.624 | 65.23 | 4.000 | 72.00 | 3.500 | 63.00 | | | | |
| | 9/16 | 4.538 | 81.68 | 4.046 | 72.83 | 4.467 | 80.41 | 3.905 | 70.29 | | | | |
| | 5/8 | 5.003 | 90.05 | 4.456 | 80.21 | 4.925 | 88.65 | 4.300 | 77.40 | | | | |
| | 11/16 | 5.458 | 98.24 | 4.856 | 87.41 | 5.372 | 96.70 | 4.685 | 84.33 | | | | |
| | 3/4 | 5.904 | 106.27 | 5.248 | 94.46 | 5.810 | 104.58 | 5.060 | 91.08 | | | | |
| | 13/16 | 6.349 | 114.28 | 5.638 | 101.48 | 6.247 | 112.45 | 5.435 | 97.83 | | | | |
| | 7/8 | 6.784 | 122.11 | 6.018 | 108.32 | 6.675 | 120.15 | 5.800 | 104.40 | | | | |
| 6 × 4 | 3/8 | 3.282 | 59.08 | 2.954 | 53.17 | 3.235 | 58.23 | 2.860 | 51.48 | 3.188 | 57.38 | 2.766 | 49.79 |
| | 7/16 | 3.797 | 68.35 | 3.414 | 61.45 | 3.742 | 67.36 | 3.304 | 59.47 | 3.688 | 66.38 | 3.196 | 57.53 |
| | 1/2 | 4.312 | 77.62 | 3.874 | 69.73 | 4.250 | 76.50 | 3.750 | 67.50 | 4.187 | 75.37 | 3.624 | 65.23 |
| | 9/16 | 4.818 | 86.72 | 4.326 | 77.87 | 4.747 | 85.45 | 4.184 | 75.31 | 4.677 | 84.19 | 4.044 | 72.79 |
| | 5/8 | 5.313 | 95.63 | 4.766 | 85.79 | 5.235 | 94.23 | 4.610 | 82.98 | 5.157 | 92.84 | 4.454 | 80.17 |
| | 11/16 | 5.798 | 104.36 | 5.196 | 93.53 | 5.712 | 102.82 | 5.024 | 90.43 | 5.627 | 101.29 | 4.854 | 87.37 |
| | 3/4 | 6.284 | 113.11 | 5.628 | 101.30 | 6.190 | 111.42 | 5.440 | 97.92 | 6.096 | 109.73 | 5.252 | 94.54 |
| | 13/16 | 6.759 | 121.66 | 6.048 | 108.86 | 6.657 | 119.83 | 5.844 | 105.19 | 6.556 | 118.01 | 5.642 | 101.56 |
| | 7/8 | 7.214 | 129.85 | 6.448 | 116.06 | 7.105 | 127.89 | 6.230 | 112.14 | 6.996 | 125.93 | 6.012 | 108.22 |
| 6 × 6 | 3/8 | 4.032 | 72.58 | 3.704 | 66.67 | 3.985 | 71.73 | 3.610 | 64.98 | 3.938 | 70.88 | 3.516 | 63.29 |
| | 7/16 | 4.677 | 84.19 | 4.294 | 77.29 | 4.622 | 83.20 | 4.184 | 75.31 | 4.568 | 82.22 | 4.076 | 73.37 |
| | 1/2 | 5.312 | 95.62 | 4.874 | 87.73 | 5.250 | 94.50 | 4.750 | 85.50 | 5.187 | 93.37 | 4.624 | 83.23 |
| | 9/16 | 5.938 | 106.88 | 5.446 | 98.03 | 5.867 | 105.61 | 5.304 | 95.47 | 5.797 | 104.35 | 5.164 | 92.95 |
| | 5/8 | 6.563 | 118.13 | 6.016 | 108.29 | 6.485 | 116.73 | 5.860 | 105.48 | 6.407 | 115.33 | 5.704 | 102.67 |
| | 11/16 | 7.178 | 129.20 | 6.576 | 118 37 | 7.092 | 127.66 | 6.404 | 115.27 | 7.007 | 126.13 | 6.234 | 112.21 |
| | 3/4 | 7.784 | 140.11 | 7.128 | 128.30 | 7.690 | 138.42 | 6.940 | 124.92 | 7.596 | 136.73 | 6.752 | 121.54 |
| | 13/16 | 8.379 | 150.82 | 7.668 | 138.02 | 8.277 | 148.99 | 7.464 | 134.35 | 8.176 | 147.17 | 7.262 | 130.72 |
| | 7/8 | 8.964 | 161.35 | 8.198 | 147.56 | 8.855 | 159.39 | 7.980 | 143.64 | 8.746 | 157.43 | 7.762 | 139.72 |
| | 15/16 | ..... | ..... | ..... | ..... | 9.432 | 169.78 | 8.494 | 152.89 | 9.315 | 167.67 | 8.260 | 148.68 |
| | 1 | ..... | ..... | ..... | ..... | 10.000 | 180.00 | 9.000 | 162.00 | 9.875 | 177.75 | 8.750 | 157.50 |
| 7 × 3½ | 3/8 | 3.472 | 62.50 | 3.144 | 56.59 | 3.425 | 61.65 | 3.050 | 54.90 | 3.378 | 60.80 | 2.956 | 53.21 |
| | 7/16 | 4.017 | 72.31 | 3.634 | 65.41 | 3.962 | 71.32 | 3.524 | 63.43 | 3.908 | 70.34 | 3.416 | 61.49 |
| | 1/2 | 4.562 | 82.12 | 4.124 | 74.23 | 4.500 | 81.00 | 4.000 | 72.00 | 4.437 | 79.87 | 3.874 | 69.73 |
| | 9/16 | 5.098 | 91.76 | 4.606 | 82.91 | 5.027 | 90.49 | 4.464 | 80.35 | 4.957 | 89.23 | 4.324 | 77.83 |
| | 5/8 | 5.623 | 101.21 | 5.076 | 91.37 | 5.545 | 99.81 | 4.920 | 88.56 | 5.467 | 98.41 | 4.764 | 85.75 |
| | 11/16 | 6.148 | 110.66 | 5.546 | 99.83 | 6.062 | 109.12 | 5.374 | 96.73 | 5.977 | 107.59 | 5.204 | 93.67 |
| | 3/4 | 6.654 | 119.77 | 5.998 | 107.96 | 6.560 | 118.08 | 5.810 | 104.58 | 6.466 | 116.39 | 5.622 | 101.20 |
| | 13/16 | 7.159 | 128.86 | 6.448 | 116.06 | 7.057 | 127.03 | 6.244 | 112.39 | 6.956 | 125.21 | 6.042 | 108.76 |
| | 7/8 | 7.654 | 137.77 | 6.888 | 123.98 | 7.545 | 135.81 | 6.670 | 120.06 | 7.436 | 133.85 | 6.452 | 116.14 |
| | 15/16 | ..... | ..... | ..... | ..... | 8.032 | 144.58 | 7.094 | 127.69 | 7.915 | 142.47 | 6.861 | 123.49 |
| | 1 | ..... | ..... | ..... | ..... | 8.500 | 153.00 | 7.500 | 135.00 | 8.375 | 150.75 | 7.250 | 130.50 |
| 8 × 6 | 7/16 | 5.547 | 99.85 | 5.164 | 92.95 | 5.492 | 98.86 | 5.054 | 90.97 | 5.438 | 97.88 | 4.946 | 89.03 |
| | 1/2 | 6.312 | 113.62 | 5.874 | 105.73 | 6.250 | 112.50 | 5.750 | 103.50 | 6.187 | 111.37 | 5.624 | 101.23 |
| | 9/16 | 7.068 | 127.22 | 6.576 | 118.37 | 6.997 | 125.95 | 6.434 | 115.81 | 6.927 | 124.69 | 6.294 | 113.29 |
| | 5/8 | 7.813 | 140.63 | 7.266 | 130.79 | 7.735 | 139.23 | 7.110 | 127.98 | 7.657 | 137.83 | 6.954 | 125.17 |
| | 11/16 | 8.548 | 153.86 | 7.946 | 143.03 | 8.462 | 152.32 | 7.774 | 139.93 | 8.377 | 150.79 | 7.604 | 136.87 |
| | 3/4 | 9.284 | 167.11 | 8.628 | 155.30 | 9.190 | 165.42 | 8.440 | 151.92 | 9.096 | 163.73 | 8.252 | 148.54 |
| | 13/16 | 10.009 | 180.16 | 9.298 | 167.36 | 9.907 | 178.33 | 9.095 | 163.71 | 9.806 | 176.51 | 8.892 | 160.06 |
| | 7/8 | 10.714 | 192.85 | 9.948 | 179.06 | 10.605 | 190.89 | 9.730 | 175.14 | 10.496 | 188.93 | 9.512 | 171.22 |
| | 15/16 | ..... | ..... | ..... | ..... | 11.312 | 203.62 | 10.374 | 186.73 | 11.195 | 201.51 | 10.140 | 182.52 |
| | 1 | ..... | ..... | ..... | ..... | 12.000 | 216.00 | 11.000 | 198.00 | 11.875 | 213.75 | 10.750 | 193.50 |
| 8 × 8 | 1/2 | 7.312 | 131.62 | 6.874 | 123.73 | 7.250 | 130.50 | 6.750 | 121.50 | 7.187 | 129.37 | 6.624 | 119.23 |
| | 9/16 | 8.188 | 147.38 | 7.696 | 138.53 | 8.117 | 146.11 | 7.554 | 135.97 | 8.047 | 144.85 | 7.414 | 133.45 |
| | 5/8 | 9.063 | 163.13 | 8.516 | 153.29 | 8.985 | 161.73 | 8.360 | 150.48 | 8.907 | 160.33 | 8.204 | 147.67 |
| | 11/16 | 9.928 | 178.70 | 9.326 | 167.87 | 9.842 | 177.16 | 9.154 | 164.77 | 9.757 | 175.63 | 8.984 | 161.71 |
| | 3/4 | 10.784 | 194.11 | 10.128 | 182.30 | 10.690 | 192.42 | 9.940 | 178.92 | 10.596 | 190.73 | 9.752 | 175.54 |
| | 13/16 | 11.629 | 209.32 | 10.918 | 196.52 | 11.527 | 207.49 | 10.714 | 192.85 | 11.426 | 205.67 | 10.512 | 189.22 |
| | 7/8 | 12.464 | 224.35 | 11.698 | 210.56 | 12.355 | 222.39 | 11.480 | 206.64 | 12.246 | 220.43 | 11.262 | 202.72 |
| | 15/16 | ..... | ..... | ..... | ..... | 13.182 | 237.28 | 12.244 | 220 39 | 13.065 | 235.17 | 12.010 | 216.18 |
| | 1 | ..... | ..... | ..... | ..... | 14.000 | 252.00 | 13.000 | 234.00 | 13.875 | 249.75 | 12.750 | 229.50 |
| | 1 1/16 | ..... | ..... | ..... | ..... | 14.807 | 266.53 | 13.744 | 247.39 | 14.675 | 264.15 | 13.480 | 242.64 |
| | 1 1/8 | ..... | ..... | ..... | ..... | 15.605 | 280.89 | 14.480 | 260.64 | 15.464 | 278.35 | 14.198 | 255.56 |

# STRUTS OF ONE ANGLE
# ALLOWABLE CONCENTRIC LOADS IN KIPS

Values given are for Least Radius of Gyration which is about Axis Z – Z.
Loads to right of heavy vertical line are for Secondary Members ONLY.

| Size in Inches | Thick-ness | Weight per foot | Area in Sq.In. | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1¾ × 1¾ | ⅛ | 1.44 | 0.42 | 0.35 | 6.0 | 4.8 | 3.7 | 2.9 | | | | | | | |
| | 3/16 | 2.12 | 0.62 | 0.34 | 8.7 | 6.9 | 5.3 | 4.1 | | | | | | | |
| | ¼ | 2.77 | 0.81 | 0.34 | 11.4 | 9.0 | 6.9 | 5.3 | | | | | | | |
| 2 × 2 | ⅛ | 1.65 | 0.48 | 0.40 | 7.2 | 6.0 | 4.8 | 3.8 | 3.1 | | | | | | |
| | 3/16 | 2.44 | 0.72 | 0.39 | 10.7 | 8.8 | 7.0 | 5.7 | 4.5 | | | | | | |
| | ¼ | 3.19 | 0.94 | 0.39 | 14.0 | 11.5 | 9.2 | 7.4 | 5.8 | | | | | | |
| | 5/16 | 3.92 | 1.15 | 0.39 | 17.1 | 14.1 | 11.2 | 9.1 | 7.2 | | | | | | |
| 2½ × 2 | ⅛ | 1.86 | 0.55 | 0.43 | 8.3 | 7.1 | 5.8 | 4.8 | 3.9 | 3.2 | | | | | |
| | 3/16 | 2.75 | 0.81 | 0.43 | 12.2 | 10.5 | 8.6 | 7.0 | 5.7 | 4.7 | | | | | |
| | ¼ | 3.62 | 1.06 | 0.42 | 15.9 | 13.5 | 11.1 | 8.9 | 7.2 | 5.9 | | | | | |
| | 5/16 | 4.50 | 1.31 | 0.42 | 19.7 | 16.7 | 13.7 | 11.0 | 8.9 | 7.3 | | | | | |
| 2½ × 2½ | ⅛ | 2.08 | 0.61 | 0.50 | 9.2 | 8.5 | 7.3 | 6.1 | 5.1 | 4.3 | 3.6 | | | | |
| | 3/16 | 3.07 | 0.90 | 0.49 | 13.5 | 12.5 | 10.6 | 8.8 | 7.4 | 6.1 | 5.2 | | | | |
| | ¼ | 4.1 | 1.19 | 0.49 | 17.9 | 16.5 | 14.0 | 11.7 | 9.7 | 8.1 | 6.8 | | | | |
| | 5/16 | 5.0 | 1.47 | 0.49 | 22.1 | 20.4 | 17.3 | 14.4 | 12.0 | 10.0 | 8.5 | | | | |
| | ⅜ | 5.9 | 1.73 | 0.48 | 26.0 | 23.7 | 20.0 | 16.7 | 13.8 | 11.5 | | | | | |
| 3 × 2½ | ¼ | 4.5 | 1.31 | 0.53 | 19.7 | 18.8 | 16.2 | 13.8 | 11.6 | 9.8 | 8.4 | | | | |
| | 5/16 | 5.6 | 1.62 | 0.53 | 24.3 | 23.2 | 20.0 | 17.0 | 14.4 | 12.2 | 10.3 | | | | |
| | ⅜ | 6.6 | 1.92 | 0.52 | 28.8 | 27.3 | 23.4 | 19.9 | 16.7 | 14.1 | 11.9 | | | | |
| | 7/16 | 7.6 | 2.22 | 0.52 | 33.3 | 31.6 | 27.1 | 23.0 | 19.4 | 16.3 | 13.8 | | | | |
| 3 × 3 | ¼ | 4.9 | 1.44 | 0.59 | 21.6 | 21.5 | 19.0 | 16.5 | 14.2 | 12.2 | 10.5 | 9.1 | | | |
| | 5/16 | 6.1 | 1.78 | 0.59 | 26.7 | 26.5 | 23.4 | 20.3 | 17.5 | 15.1 | 13.0 | 11.2 | | | |
| | ⅜ | 7.2 | 2.11 | 0.58 | 31.7 | 31.3 | 27.5 | 23.8 | 20.5 | 17.5 | 15.1 | 13.0 | | | |
| | 7/16 | 8.3 | 2.43 | 0.58 | 36.5 | 36.0 | 31.7 | 27.4 | 23.6 | 20.2 | 17.4 | 14.9 | | | |
| | ½ | 9.4 | 2.75 | 0.58 | 41.3 | 40.8 | 35.9 | 31.0 | 26.7 | 22.9 | 19.6 | 16.9 | | | |
| 3½ × 2½ | ¼ | 4.9 | 1.44 | 0.54 | 21.6 | 20.8 | 18.0 | 15.4 | 13.0 | 11.1 | 9.4 | 8.0 | | | |
| | 5/16 | 6.1 | 1.78 | 0.54 | 26.7 | 26.7 | 22.3 | 19.0 | 16.1 | 13.7 | 11.6 | 9.9 | | | |
| | ⅜ | 7.2 | 2.11 | 0.54 | 31.7 | 30.4 | 26.4 | 22.5 | 19.1 | 16.2 | 13.8 | 11.8 | | | |
| | 7/16 | 8.3 | 2.43 | 0.54 | 36.5 | 35.1 | 30.4 | 26.0 | 22.0 | 18.7 | 15.9 | 13.6 | | | |
| | ½ | 9.4 | 2.75 | 0.53 | 41.3 | 39.4 | 34.0 | 28.9 | 24.4 | 20.7 | 17.5 | | | | |
| 3½ × 3½ | 5/16 | 7.2 | 2.09 | 0.69 | 31.4 | 31.4 | 29.6 | 26.5 | 23.4 | 20.6 | 18.1 | 15.9 | 14.0 | 12.4 | |
| | ⅜ | 8.5 | 2.48 | 0.68 | 37.2 | 37.2 | 35.0 | 31.2 | 27.5 | 24.2 | 21.2 | 18.6 | 16.3 | 14.4 | |
| | 7/16 | 9.8 | 2.87 | 0.68 | 43.1 | 43.1 | 40.5 | 36.1 | 31.8 | 28.0 | 24.5 | 21.5 | 18.9 | 16 7 | |
| | ½ | 11.1 | 3.25 | 0.68 | 48.8 | 48.8 | 45.8 | 40.9 | 36.0 | 31.7 | 27.8 | 24.4 | 21.4 | 18.9 | |
| | 9/16 | 12.4 | 3.62 | 0.68 | 54.3 | 54.3 | 51.0 | 45.5 | 40.1 | 35.3 | 30.9 | 27.2 | 23.9 | 21.1 | |
| | ⅝ | 13.6 | 3.98 | 0.68 | 59.7 | 59.7 | 56.1 | 50.0 | 44.1 | 38.8 | 34.0 | 29.9 | 26.2 | 23.2 | |
| 4 × 3 | 5/16 | 7.2 | 2.09 | 0.65 | 31.4 | 31.4 | 28.9 | 25.5 | 22.4 | 19.5 | 17.0 | 14 8 | 13.0 | | |
| | ⅜ | 8.5 | 2.48 | 0.64 | 37.2 | 37.2 | 34.0 | 30.0 | 26.2 | 22.8 | 19.8 | 17.3 | 15.1 | | |
| | 7/16 | 9.8 | 2.87 | 0.64 | 43.1 | 43.1 | 39.4 | 34.7 | 30.3 | 26.4 | 23.0 | 20.0 | 17.5 | | |
| | ½ | 11.1 | 3.25 | 0.64 | 48.8 | 48.8 | 44.6 | 39.3 | 34.4 | 29.9 | 26.0 | 22.7 | 19.8 | | |
| | 9/16 | 12.4 | 3.62 | 0.64 | 54.3 | 54.3 | 49.6 | 43.8 | 38.3 | 33.3 | 29.0 | 25.2 | 22.1 | | |
| | ⅝ | 13.6 | 3.98 | 0 64 | 59.7 | 59.7 | 54.6 | 48.1 | 42 1 | 36 6 | 31.8 | 27.7 | 24.3 | | |
| 4 × 3½ | 5/16 | 7.7 | 2.25 | 0 73 | 33.8 | 33.8 | 32.6 | 29.5 | 26.3 | 23.3 | 20.7 | 18.3 | 16.2 | 14.4 | 12.8 |
| | ⅜ | 9.1 | 2.67 | 0.73 | 40.1 | 40.1 | 38.7 | 35.0 | 31.2 | 27.7 | 24.5 | 21.7 | 19.2 | 17.1 | 15.2 |
| | 7/16 | 10.6 | 3.09 | 0.72 | 46.4 | 46.4 | 44.6 | 40.1 | 35.8 | 31.7 | 28.0 | 24.7 | 21.9 | 19.4 | 17.2 |
| | ½ | 11.9 | 3.50 | 0.72 | 52.5 | 52.5 | 50.5 | 45.5 | 40.5 | 35.9 | 31.7 | 28.0 | 24.8 | 22.0 | 19.5 |
| | 9/16 | 13.3 | 3.90 | 0.72 | 58.5 | 58.5 | 56.3 | 50.7 | 45.1 | 40.0 | 35.3 | 31.2 | 27.6 | 24.5 | 21.8 |
| | ⅝ | 14.7 | 4.30 | 0.72 | 64.5 | 64.5 | 62.1 | 55.9 | 49.8 | 44.1 | 39.0 | 34.4 | 30.4 | 27.0 | 24.0 |
| | 11/16 | 16.0 | 4.68 | 0.72 | 70.2 | 70.2 | 67.6 | 60 8 | 54.1 | 48.0 | 42.4 | 37.4 | 33.1 | 29.4 | 26.1 |
| | ¾ | 17.3 | 5.06 | 0.72 | 75.9 | 75.9 | 73.1 | 65.7 | 58.5 | 51.9 | 45.8 | 40.5 | 35.8 | 31.8 | 28.2 |
| 4 × 4 | 5/16 | 8.2 | 2.40 | 0.79 | 36.0 | 36.0 | 35.9 | 32.7 | 29.6 | 26.5 | 23.7 | 21.2 | 18.9 | 16.9 | 15.2 |
| | ⅜ | 9.8 | 2.86 | 0.79 | 42 9 | 42 9 | 42.7 | 39.0 | 35.2 | 31.6 | 28.3 | 25.3 | 22.6 | 20.2 | 18.1 |
| | 7/16 | 11.3 | 3 31 | 0.78 | 49.7 | 49.7 | 49.2 | 44.9 | 40.4 | 36.2 | 32.3 | 28.9 | 25.7 | 23.0 | 20.6 |
| | ½ | 12.8 | 3.75 | 0.78 | 56.3 | 56.3 | 55.8 | 50.8 | 45.8 | 41.1 | 36.6 | 32.7 | 29.1 | 26.1 | 23.3 |
| | 9/16 | 14.3 | 4.18 | 0.78 | 62.7 | 62.7 | 62.2 | 56.6 | 51.1 | 45.8 | 40.8 | 36.4 | 32.5 | 29.1 | 26.0 |
| | ⅝ | 15.7 | 4.61 | 0.77 | 69.2 | 69.2 | 68.2 | 62.1 | 55.9 | 50.0 | 44.5 | 39.6 | 35.3 | 31.5 | 28.2 |
| | 11/16 | 17.1 | 5.03 | 0.77 | 75.5 | 75.5 | 74.4 | 67.7 | 61.0 | 54.5 | 48.6 | 43.3 | 38.5 | 34.4 | 30.8 |
| | ¾ | 18.5 | 5.44 | 0.77 | 81.6 | 81.6 | 80.5 | 73.2 | 65.9 | 59.0 | 52.6 | 46.8 | 41.7 | 37.2 | 33.3 |
| 5 × 3 | 5/16 | 8.2 | 2.40 | 0.66 | 36.0 | 36.0 | 33.4 | 29.6 | 26.0 | 22.8 | 19.8 | 17.4 | 15.2 | 13.4 | |
| | ⅜ | 9.8 | 2.86 | 0.65 | 42.9 | 42.9 | 39.5 | 34.9 | 30.6 | 26.7 | 23.3 | 20.3 | 17.8 | | |
| | 7/16 | 11.3 | 3.31 | 0.65 | 49.7 | 49.7 | 45.7 | 40.4 | 35.4 | 30.9 | 26.9 | 23.5 | 20.6 | | |
| | ½ | 12.8 | 3.75 | 0.65 | 56.3 | 56.3 | 51.8 | 45.8 | 40.1 | 35.0 | 30.5 | 26.6 | 23.3 | | |
| | 9/16 | 14.3 | 4.18 | 0.65 | 62.7 | 62.7 | 57.8 | 51.1 | 44.7 | 39.0 | 34.0 | 29.7 | 26.0 | | |
| | ⅝ | 15.7 | 4.61 | 0.64 | 69.2 | 69.2 | 63.2 | 55.7 | 48.7 | 42.4 | 36.9 | 32.1 | 28.1 | | |
| | 11/16 | 17.1 | 5.03 | 0.64 | 75.5 | 75.5 | 69.0 | 60.8 | 53.2 | 46.3 | 40.2 | 35.1 | 30.7 | | |
| | ¾ | 18.5 | 5.44 | 0.64 | 81.6 | 81.6 | 74.6 | 65.8 | 57.5 | 50.0 | 43.5 | 37.9 | 33.2 | | |

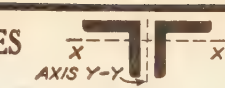
# STRUTS OF ONE ANGLE
# ALLOWABLE CONCENTRIC LOADS IN KIPS

Values given are for Least Radius of Gyration which is about Axis Z – Z.
Loads to right of heavy vertical line are for Secondary Members ONLY.

| Size in Inches | Thickness | Weight per foot | Area Sq. Inches | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
| 5 × 3½ | 5/16 | 8.7 | 2.56 | 0.77 | 38 | 38 | 34 | 31 | 28 | 25 | 20 | 16 | | | | | |
| | 3/8 | 10.4 | 3.05 | 0.76 | 46 | 45 | 41 | 37 | 33 | 29 | 23 | 18 | | | | | |
| | 7/16 | 12.0 | 3.53 | 0.76 | 53 | 52 | 47 | 42 | 38 | 34 | 27 | 21 | | | | | |
| | 1/2 | 13.6 | 4.00 | 0.75 | 60 | 59 | 53 | 48 | 42 | 38 | 30 | 24 | | | | | |
| | 9/16 | 15.2 | 4.47 | 0.75 | 67 | 66 | 59 | 53 | 47 | 42 | 33 | 26 | | | | | |
| | 5/8 | 16.8 | 4.92 | 0.75 | 74 | 72 | 65 | 59 | 52 | 46 | 37 | 29 | | | | | |
| | 11/16 | 18.3 | 5.37 | 0.75 | 81 | 79 | 71 | 64 | 57 | 51 | 40 | 32 | | | | | |
| | 3/4 | 19.8 | 5.81 | 0.75 | 87 | 85 | 77 | 69 | 62 | 55 | 43 | 34 | | | | | |
| 6 × 3½ | 3/8 | 11.7 | 3.42 | 0.77 | 51 | 51 | 46 | 41 | 37 | 33 | 26 | 21 | | | | | |
| | 7/16 | 13.5 | 3.97 | 0.76 | 60 | 58 | 53 | 48 | 43 | 38 | 30 | 24 | | | | | |
| | 1/2 | 15.3 | 4.50 | 0.76 | 68 | 66 | 60 | 54 | 48 | 43 | 34 | 27 | | | | | |
| | 9/16 | 17.1 | 5.03 | 0.75 | 75 | 74 | 67 | 60 | 53 | 47 | 37 | 30 | | | | | |
| | 5/8 | 18.9 | 5.55 | 0.75 | 83 | 81 | 74 | 66 | 59 | 52 | 41 | 33 | | | | | |
| | 11/16 | 20.6 | 6.06 | 0.75 | 91 | 89 | 80 | 72 | 64 | 57 | 45 | 36 | | | | | |
| | 3/4 | 22.4 | 6.56 | 0.75 | 98 | 96 | 87 | 78 | 70 | 62 | 49 | 39 | | | | | |
| | 13/16 | 24.0 | 7.06 | 0.75 | 106 | 103 | 94 | 84 | 75 | 67 | 52 | 42 | | | | | |
| | 7/8 | 25.7 | 7.55 | 0.75 | 113 | 111 | 100 | 90 | 80 | 71 | 56 | 45 | | | | | |
| 6 × 4 | 3/8 | 12.3 | 3.61 | 0.88 | 54 | 54 | 52 | 47 | 43 | 39 | 32 | 26 | | | | | |
| | 7/16 | 14.3 | 4.18 | 0.87 | 63 | 63 | 60 | 55 | 50 | 45 | 37 | 30 | 24 | | | | |
| | 1/2 | 16.2 | 4.75 | 0.87 | 71 | 71 | 68 | 62 | 56 | 51 | 42 | 34 | 28 | | | | |
| | 9/16 | 18.1 | 5.31 | 0.87 | 80 | 80 | 76 | 69 | 63 | 57 | 46 | 38 | 31 | | | | |
| | 5/8 | 20.0 | 5.86 | 0.86 | 88 | 88 | 83 | 76 | 69 | 62 | 51 | 41 | 34 | | | | |
| | 11/16 | 21.8 | 6.40 | 0.86 | 96 | 96 | 91 | 83 | 75 | 68 | 55 | 45 | 37 | | | | |
| | 3/4 | 23.6 | 6.94 | 0.86 | 104 | 104 | 98 | 90 | 82 | 74 | 60 | 49 | 40 | | | | |
| | 13/16 | 25.4 | 7.47 | 0.86 | 112 | 112 | 106 | 97 | 88 | 79 | 65 | 53 | 43 | | | | |
| | 7/8 | 27.2 | 7.98 | 0.86 | 120 | 120 | 113 | 103 | 94 | 85 | 69 | 56 | 46 | | | | |
| 6 × 6 | 3/8 | 14.9 | 4.36 | 1.19 | 65 | 65 | 65 | 65 | 61 | 58 | 50 | 43 | 37 | 32 | 28 | | |
| | 7/16 | 17.2 | 5.06 | 1.19 | 76 | 76 | 76 | 76 | 71 | 67 | 58 | 51 | 43 | 37 | 32 | | |
| | 1/2 | 19.6 | 5.75 | 1.18 | 86 | 86 | 86 | 86 | 81 | 76 | 66 | 57 | 49 | 42 | 36 | | |
| | 9/16 | 21.9 | 6.43 | 1.18 | 96 | 96 | 96 | 96 | 90 | 85 | 73 | 63 | 54 | 47 | 40 | | |
| | 5/8 | 24.2 | 7.11 | 1.17 | 107 | 107 | 107 | 106 | 99 | 93 | 81 | 69 | 60 | 51 | 44 | | |
| | 11/16 | 26.5 | 7.78 | 1.17 | 117 | 117 | 117 | 116 | 109 | 102 | 88 | 76 | 65 | 56 | 48 | | |
| | 3/4 | 28.7 | 8.44 | 1.17 | 127 | 127 | 127 | 126 | 118 | 111 | 96 | 82 | 71 | 61 | 52 | | |
| | 13/16 | 31.0 | 9.09 | 1.17 | 136 | 136 | 136 | 135 | 127 | 119 | 103 | 89 | 76 | 66 | 57 | | |
| | 7/8 | 33.1 | 9.73 | 1.16 | 146 | 146 | 146 | 144 | 136 | 127 | 110 | 94 | 81 | 69 | 60 | | |
| | 15/16 | 35.3 | 10.37 | 1.16 | 156 | 156 | 156 | 154 | 144 | 135 | 117 | 100 | 86 | 74 | 64 | | |
| | 1 | 37.4 | 11.00 | 1.16 | 165 | 165 | 165 | 163 | 153 | 143 | 124 | 107 | 91 | 78 | 68 | | |
| 7 × 3½ | 3/8 | 13.0 | 3.80 | 0.76 | 57 | 56 | 51 | 46 | 41 | 36 | 29 | 23 | | | | | |
| | 7/16 | 15.0 | 4.40 | 0.76 | 66 | 65 | 59 | 53 | 47 | 42 | 33 | 26 | | | | | |
| | 1/2 | 17.0 | 5.00 | 0.75 | 75 | 73 | 66 | 60 | 53 | 47 | 37 | 30 | | | | | |
| | 9/16 | 19.1 | 5.59 | 0.75 | 84 | 82 | 74 | 67 | 59 | 53 | 42 | 33 | | | | | |
| | 5/8 | 21.0 | 6.17 | 0.75 | 93 | 90 | 82 | 73 | 65 | 58 | 46 | 36 | | | | | |
| | 11/16 | 23.0 | 6.75 | 0.74 | 101 | 98 | 89 | 80 | 71 | 63 | 49 | 39 | | | | | |
| | 3/4 | 24.9 | 7.31 | 0.74 | 110 | 107 | 96 | 86 | 77 | 68 | 54 | 42 | | | | | |
| | 13/16 | 26.8 | 7.87 | 0.74 | 118 | 115 | 104 | 93 | 83 | 73 | 58 | 46 | | | | | |
| | 7/8 | 28.7 | 8.42 | 0.74 | 126 | 123 | 111 | 99 | 88 | 78 | 62 | 49 | | | | | |
| | 15/16 | 30.5 | 8.97 | 0.74 | 135 | 131 | 118 | 106 | 94 | 84 | 66 | 52 | | | | | |
| | 1 | 32.3 | 9.50 | 0.74 | 143 | 139 | 125 | 112 | 100 | 88 | 70 | 55 | | | | | |
| 8 × 6 | 7/16 | 20.2 | 5.93 | 1.30 | 89 | 89 | 89 | 89 | 87 | 82 | 72 | 63 | 55 | 48 | 42 | 37 | |
| | 1/2 | 23.0 | 6.75 | 1.30 | 101 | 101 | 101 | 101 | 99 | 93 | 82 | 72 | 63 | 55 | 48 | 42 | |
| | 9/16 | 25.7 | 7.56 | 1.30 | 113 | 113 | 113 | 113 | 110 | 104 | 92 | 81 | 71 | 61 | 54 | 47 | |
| | 5/8 | 28.5 | 8.36 | 1.29 | 125 | 125 | 125 | 125 | 122 | 115 | 102 | 89 | 77 | 67 | 59 | 51 | |
| | 11/16 | 31.2 | 9.15 | 1.29 | 137 | 137 | 137 | 137 | 133 | 126 | 111 | 97 | 85 | 74 | 64 | 56 | |
| | 3/4 | 33.8 | 9.94 | 1.28 | 149 | 149 | 149 | 149 | 144 | 136 | 120 | 105 | 91 | 80 | 69 | 61 | |
| | 13/16 | 36.5 | 10.72 | 1.28 | 161 | 161 | 161 | 161 | 156 | 147 | 130 | 113 | 99 | 86 | 75 | 65 | |
| | 7/8 | 39.1 | 11.48 | 1.28 | 172 | 172 | 172 | 172 | 167 | 157 | 139 | 121 | 106 | 92 | 80 | 70 | |
| | 15/16 | 41.7 | 12.25 | 1.28 | 184 | 184 | 184 | 184 | 178 | 168 | 148 | 129 | 113 | 98 | 85 | 75 | |
| | 1 | 44.2 | 13.00 | 1.28 | 195 | 195 | 195 | 195 | 189 | 178 | 157 | 137 | 120 | 104 | 91 | 79 | |
| 8 × 8 | 1/2 | 26.4 | 7.75 | 1.59 | 116 | 116 | 116 | 116 | 116 | 116 | 106 | 96 | 86 | 77 | 69 | 62 | 55 |
| | 9/16 | 29.6 | 8.68 | 1.58 | 130 | 130 | 130 | 130 | 130 | 130 | 118 | 107 | 96 | 86 | 77 | 68 | 61 |
| | 5/8 | 32.7 | 9.61 | 1.58 | 144 | 144 | 144 | 144 | 144 | 144 | 131 | 118 | 106 | 95 | 85 | 76 | 68 |
| | 11/16 | 35.8 | 10.53 | 1.58 | 158 | 158 | 158 | 158 | 158 | 157 | 144 | 130 | 116 | 104 | 93 | 83 | 74 |
| | 3/4 | 38.9 | 11.44 | 1.57 | 172 | 172 | 172 | 172 | 172 | 170 | 155 | 140 | 126 | 112 | 100 | 90 | 80 |
| | 13/16 | 42.0 | 12.34 | 1.57 | 185 | 185 | 185 | 185 | 185 | 184 | 168 | 151 | 136 | 121 | 108 | 97 | 86 |
| | 7/8 | 45.0 | 13.23 | 1.56 | 198 | 198 | 198 | 198 | 198 | 197 | 179 | 162 | 145 | 129 | 115 | 103 | 92 |
| | 15/16 | 48.1 | 14.12 | 1.56 | 212 | 212 | 212 | 212 | 212 | 210 | 191 | 173 | 155 | 138 | 123 | 110 | 98 |
| | 1 | 51.0 | 15.00 | 1.56 | 225 | 225 | 225 | 225 | 225 | 223 | 203 | 183 | 164 | 147 | 131 | 117 | 104 |
| | 1 1/16 | 54.0 | 15.87 | 1.56 | 238 | 238 | 238 | 238 | 238 | 236 | 215 | 194 | 174 | 155 | 138 | 123 | 110 |
| | 1 1/8 | 56.9 | 16.73 | 1.55 | 251 | 251 | 251 | 251 | 251 | 248 | 226 | 203 | 182 | 162 | 145 | 129 | 115 |

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO EQUAL ANGLES

Loads to right of heavy vertical lines are for Secondary Members ONLY.



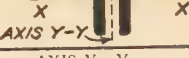

3/8" BACK TO BACK

| Size | Thickness | Two Angles | | Radius of Gyration | | AXIS X-X Unsupported Length in Feet | | | | | | | | | | | | AXIS Y-Y Unsupported Length in Feet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | Weight | X-X | Y-Y | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 |
| 2½ × 2½ | 3/16 | 1.80 | 6 1 | .78 | 1.18 | 27 | 27 | 24 | 22 | 20 | 18 | 16 | 14 | 11 | ... | ... | ... | ... | 27 | 25 | 24 | 22 | 21 | 18 | 15 | 13 | 11 | | | |
| | 1/4 | 2.38 | 8 2 | .77 | 1 19 | 36 | 35 | 32 | 29 | 26 | 23 | 21 | 18 | 15 | ... | ... | ... | ... | 36 | 34 | 31 | 29 | 27 | 24 | 20 | 18 | 15 | | | |
| | 5/16 | 2.94 | 10 0 | .76 | 1 20 | 44 | 43 | 39 | 35 | 32 | 28 | 25 | 22 | 18 | ... | ... | ... | ... | 44 | 42 | 39 | 36 | 34 | 29 | 25 | 22 | 19 | 16 | | |
| | 3/8 | 3.46 | 11 8 | .75 | 1 21 | 52 | 51 | 46 | 41 | 37 | 33 | 29 | 26 | 20 | ... | ... | ... | ... | 52 | 49 | 46 | 43 | 40 | 35 | 30 | 26 | 23 | | | |
| 3 × 3 | 1/4 | 2.88 | 9 8 | .93 | 1 38 | 43 | 43 | 42 | 39 | 36 | 33 | 30 | 27 | 22 | 18 | ... | ... | ... | 43 | 43 | 41 | 39 | 37 | 32 | 28 | 25 | 22 | 19 | 17 | |
| | 5/16 | 3.56 | 12 2 | .92 | 1 40 | 53 | 53 | 52 | 48 | 44 | 40 | 36 | 33 | 27 | 23 | ... | ... | ... | 53 | 53 | 51 | 48 | 46 | 40 | 36 | 31 | 28 | 24 | 22 | |
| | 3/8 | 4.22 | 14 4 | .91 | 1.41 | 63 | 63 | 61 | 56 | 52 | 47 | 43 | 39 | 32 | 26 | ... | ... | ... | 63 | 63 | 60 | 57 | 54 | 48 | 42 | 37 | 33 | 29 | 26 | |
| | 7/16 | 4.86 | 16 6 | .91 | 1 42 | 73 | 73 | 71 | 65 | 59 | 54 | 49 | 45 | 37 | 30 | ... | ... | ... | 73 | 73 | 70 | 66 | 63 | 56 | 49 | 43 | 38 | 34 | 30 | |
| 3½ × 3½ | 5/16 | 4.18 | 14 4 | 1.08 | 1 60 | 63 | 63 | 63 | 60 | 56 | 52 | 48 | 45 | 38 | 32 | 27 | ... | ... | 63 | 63 | 63 | 60 | 57 | 52 | 47 | 42 | 37 | 33 | 30 | 27 | 24 |
| | 3/8 | 4.96 | 17.0 | 1.07 | 1 61 | 74 | 74 | 74 | 71 | 67 | 62 | 57 | 53 | 45 | 38 | 32 | ... | ... | 74 | 74 | 74 | 71 | 68 | 62 | 56 | 50 | 45 | 40 | 36 | 32 | 29 |
| | 7/16 | 5.74 | 19 6 | 1.07 | 1.62 | 86 | 86 | 86 | 83 | 77 | 71 | 66 | 61 | 52 | 44 | 37 | ... | ... | 86 | 86 | 86 | 83 | 79 | 72 | 65 | 58 | 52 | 47 | 42 | 37 | 34 |
| | 1/2 | 6.50 | 22 2 | 1 06 | 1.63 | 98 | 98 | 98 | 93 | 87 | 80 | 74 | 68 | 58 | 49 | 41 | ... | ... | 98 | 98 | 98 | 94 | 90 | 82 | 74 | 66 | 59 | 53 | 48 | 43 | 39 |
| | 9/16 | 7.24 | 24 8 | 1.05 | 1 64 | 109 | 109 | 109 | 103 | 96 | 89 | 82 | 76 | 64 | 54 | 46 | ... | ... | 109 | 109 | 109 | 105 | 100 | 91 | 82 | 74 | 66 | 59 | 53 | 48 | 43 |
| | 5/8 | 7.96 | 27 2 | 1.04 | 1 66 | 119 | 119 | 119 | 113 | 105 | 97 | 90 | 82 | 69 | 59 | 50 | ... | ... | 119 | 119 | 119 | 116 | 111 | 101 | 91 | 82 | 74 | 66 | 60 | 54 | 48 |
| 4 × 4 | 5/16 | 4.80 | 16 4 | 1.24 | 1 80 | 72 | 72 | 72 | 72 | 69 | 65 | 61 | 57 | 49 | 43 | 37 | 32 | ... | 72 | 72 | 72 | 72 | 69 | 64 | 58 | 53 | 48 | 44 | 39 | 36 | 32 |
| | 3/8 | 5.72 | 19 6 | 1.23 | 1.81 | 86 | 86 | 86 | 86 | 82 | 77 | 72 | 67 | 59 | 51 | 44 | 38 | ... | 86 | 86 | 86 | 86 | 83 | 76 | 70 | 63 | 57 | 52 | 47 | 43 | 39 |
| | 7/16 | 6 62 | 22 6 | 1.23 | 1.82 | 99 | 99 | 99 | 99 | 95 | 89 | 83 | 78 | 68 | 59 | 51 | 44 | ... | 99 | 99 | 99 | 99 | 96 | 88 | 81 | 74 | 67 | 61 | 55 | 50 | 45 |
| | 1/2 | 7 50 | 25.6 | 1.22 | 1.83 | 113 | 113 | 113 | 113 | 107 | 100 | 94 | 88 | 76 | 66 | 57 | 49 | ... | 113 | 113 | 113 | 113 | 109 | 100 | 92 | 84 | 76 | 69 | 63 | 57 | 52 |
| | 9/16 | 8.36 | 28.6 | 1.21 | 1 85 | 125 | 125 | 125 | 125 | 119 | 111 | 104 | 97 | 84 | 73 | 63 | 54 | ... | 125 | 125 | 125 | 125 | 122 | 113 | 103 | 94 | 86 | 78 | 71 | 64 | 58 |
| | 5/8 | 9 22 | 31 4 | 1.20 | 1 86 | 138 | 138 | 138 | 138 | 131 | 122 | 114 | 107 | 92 | 79 | 69 | 59 | ... | 138 | 138 | 138 | 138 | 135 | 124 | 114 | 104 | 95 | 86 | 78 | 71 | 65 |
| 6 × 6 | 3/8 | 8.72 | 29 8 | 1.88 | 2 62 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 128 | 118 | 109 | 99 | 91 | 82 | 131 | 131 | 131 | 131 | 131 | 131 | 128 | 121 | 114 | 107 | 100 | 94 | 88 |
| | 7/16 | 10.12 | 34.4 | 1.87 | 2.63 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 148 | 137 | 126 | 115 | 105 | 95 | 152 | 152 | 152 | 152 | 152 | 152 | 148 | 140 | 132 | 125 | 117 | 109 | 102 |
| | 1/2 | 11.50 | 39.2 | 1.86 | 2.64 | 173 | 173 | 173 | 173 | 173 | 173 | 173 | 168 | 155 | 143 | 130 | 118 | 108 | 173 | 173 | 173 | 173 | 173 | 173 | 169 | 160 | 151 | 142 | 133 | 125 | 117 |
| | 9/16 | 12.86 | 43 8 | 1.85 | 2.65 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 188 | 173 | 159 | 145 | 132 | 120 | 193 | 193 | 193 | 193 | 193 | 193 | 189 | 179 | 169 | 159 | 149 | 140 | 131 |
| | 5/8 | 14 22 | 48.4 | 1.84 | 2.66 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 207 | 191 | 175 | 160 | 145 | 132 | 213 | 213 | 213 | 213 | 213 | 213 | 210 | 198 | 187 | 176 | 165 | 155 | 145 |
| | 11/16 | 15.56 | 53.0 | 1.83 | 2 67 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 226 | 208 | 191 | 174 | 158 | 143 | 233 | 233 | 233 | 233 | 233 | 233 | 230 | 218 | 205 | 193 | 182 | 170 | 159 |
| | 3/4 | 16.88 | 57.4 | 1.83 | 2 68 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 245 | 226 | 207 | 189 | 171 | 156 | 253 | 253 | 253 | 253 | 253 | 253 | 249 | 236 | 223 | 210 | 197 | 185 | 173 |
| | 13/16 | 18.18 | 62.0 | 1.82 | 2.69 | 273 | 273 | 273 | 273 | 273 | 273 | 273 | 264 | 243 | 222 | 202 | 184 | 167 | 273 | 273 | 273 | 273 | 273 | 273 | 269 | 255 | 241 | 227 | 213 | 200 | 187 |
| | 7/8 | 19.46 | 66 2 | 1.81 | 2.70 | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 282 | 259 | 237 | 216 | 196 | 177 | 292 | 292 | 292 | 292 | 292 | 292 | 288 | 273 | 258 | 243 | 229 | 215 | 201 |
| | 15/16 | 20.74 | 70 6 | 1.80 | 2.71 | 311 | 311 | 311 | 311 | 311 | 311 | 311 | 300 | 275 | 252 | 229 | 207 | 188 | 311 | 311 | 311 | 311 | 311 | 311 | 308 | 292 | 276 | 260 | 245 | 229 | 215 |
| | 1" | 22.00 | 74 8 | 1.80 | 2.72 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 318 | 292 | 267 | 243 | 220 | 199 | 330 | 330 | 330 | 330 | 330 | 330 | 327 | 310 | 293 | 277 | 260 | 244 | 229 |
| 8 × 8 | 1/2 | 15.50 | 52.8 | 2.51 | 3.44 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 223 | 211 | 198 | 185 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 229 | 219 | 210 | 201 | 191 | |
| | 9/16 | 17.36 | 59.2 | 2 50 | 3.46 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 250 | 235 | 221 | 207 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 257 | 247 | 236 | 226 | 215 |
| | 5/8 | 19.22 | 65.4 | 2.49 | 3.47 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 276 | 260 | 244 | 228 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 285 | 273 | 262 | 250 | 239 |
| | 11/16 | 21.06 | 71.6 | 2.48 | 3.48 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 302 | 284 | 267 | 249 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 312 | 300 | 287 | 275 | 262 |
| | 3/4 | 22.88 | 77.8 | 2.47 | 3.49 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 328 | 308 | 289 | 270 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 340 | 326 | 313 | 299 | 285 |
| | 13/16 | 24.68 | 84.0 | 2.46 | 3.50 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 353 | 332 | 311 | 291 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 367 | 352 | 338 | 323 | 308 |
| | 7/8 | 26.46 | 90.0 | 2.45 | 3.51 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 378 | 355 | 333 | 311 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 393 | 378 | 362 | 347 | 331 |
| | 15/16 | 28.24 | 96.2 | 2.44 | 3.52 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 402 | 378 | 354 | 331 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 420 | 404 | 387 | 371 | 354 |
| | 1" | 30 00 | 102.0 | 2.44 | 3.53 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 428 | 402 | 376 | 351 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 447 | 430 | 412 | 394 | 377 |
| | 1 1/16 | 31.74 | 108.0 | 2.43 | 3.54 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 451 | 424 | 397 | 370 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 473 | 455 | 436 | 418 | 399 |
| | 1 1/8 | 33.46 | 113 8 | 2.42 | 3.55 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 475 | 446 | 417 | 389 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 499 | 480 | 461 | 441 | 421 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO EQUAL ANGLES

Loads to right of heavy vertical lines are for Secondary Members ONLY.




1/2" BACK TO BACK

| Size | Thickness | Two Angles Area | Two Angles Weight | Radius of Gyration X-X | Radius of Gyration Y-Y | AXIS X - X Unsupported Length in Feet 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | AXIS Y - Y Unsupported Length in Feet 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2½ × 2½ | 3/16 | 1.80 | 6.1 | .78 | 1.22 | 27 | 27 | 24 | 22 | 20 | 18 | 16 | 14 | 11 | ... | ... | ... | ... | 27 | 26 | 24 | 23 | 21 | 18 | 16 | 14 | 12 | | | |
| | 1/4 | 2.38 | 8.2 | .77 | 1.24 | 36 | 35 | 32 | 29 | 26 | 23 | 21 | 18 | 15 | ... | ... | ... | ... | 36 | 34 | 32 | 30 | 28 | 24 | 21 | 18 | 16 | 14 | | | |
| | 5/16 | 2.94 | 10 0 | .76 | 1.25 | 44 | 43 | 39 | 35 | 32 | 28 | 25 | 22 | 18 | ... | ... | ... | ... | 44 | 42 | 40 | 37 | 35 | 30 | 26 | 23 | 20 | 17 | | | |
| | 3/8 | 3.46 | 11 8 | .75 | 1.26 | 52 | 51 | 46 | 41 | 37 | 33 | 29 | 26 | 20 | ... | ... | ... | ... | 52 | 50 | 47 | 44 | 42 | 36 | 31 | 27 | 24 | 21 | | | |
| 3 × 3 | 1/4 | 2.88 | 9.8 | .93 | 1.43 | 43 | 43 | 42 | 39 | 36 | 33 | 30 | 27 | 22 | 18 | ... | ... | ... | 43 | 43 | 41 | 39 | 37 | 33 | 29 | 26 | 23 | 20 | 18 | | |
| | 5/16 | 3.56 | 12.2 | .92 | 1.45 | 53 | 53 | 52 | 48 | 44 | 40 | 36 | 33 | 27 | 23 | ... | ... | ... | 53 | 53 | 52 | 49 | 46 | 41 | 37 | 32 | 29 | 25 | 23 | 20 | |
| | 3/8 | 4.22 | 14.4 | .91 | 1.46 | 63 | 63 | 61 | 56 | 52 | 47 | 43 | 39 | 32 | 26 | ... | ... | ... | 63 | 63 | 61 | 58 | 55 | 50 | 44 | 39 | 34 | 31 | 27 | 24 | |
| | 7/16 | 4 86 | 16 6 | .91 | 1 47 | 73 | 73 | 71 | 65 | 59 | 54 | 49 | 45 | 37 | 30 | ... | ... | ... | 73 | 73 | 71 | 67 | 64 | 57 | 51 | 45 | 40 | 35 | 31 | 28 | |
| 3½ × 3½ | 5/16 | 4.18 | 14 4 | 1 08 | 1.65 | 63 | 63 | 63 | 60 | 56 | 52 | 48 | 45 | 38 | 32 | 27 | ... | ... | 63 | 63 | 63 | 61 | 58 | 53 | 48 | 43 | 39 | 35 | 31 | 28 | 25 |
| | 3/8 | 4.96 | 17 0 | 1.07 | 1.66 | 74 | 74 | 74 | 71 | 67 | 62 | 57 | 53 | 45 | 38 | 32 | ... | ... | 74 | 74 | 74 | 72 | 69 | 63 | 57 | 51 | 46 | 41 | 37 | 34 | 30 |
| | 7/16 | 5.74 | 19.6 | 1.07 | 1.67 | 86 | 86 | 86 | 83 | 77 | 71 | 66 | 61 | 52 | 44 | 37 | ... | ... | 86 | 86 | 86 | 84 | 80 | 73 | 66 | 60 | 54 | 48 | 43 | 39 | 35 |
| | 1/2 | 6.50 | 22.2 | 1.06 | 1 68 | 98 | 98 | 98 | 93 | 87 | 80 | 74 | 68 | 58 | 49 | 41 | ... | ... | 98 | 98 | 98 | 95 | 91 | 83 | 75 | 68 | 61 | 55 | 49 | 44 | 40 |
| | 9/16 | 7.24 | 24.8 | 1.05 | 1 69 | 109 | 109 | 109 | 103 | 96 | 89 | 82 | 76 | 64 | 54 | 46 | ... | ... | 109 | 109 | 109 | 106 | 102 | 93 | 84 | 76 | 68 | 61 | 55 | 50 | 45 |
| | 5/8 | 7 96 | 27 2 | 1 04 | 1 70 | 119 | 119 | 119 | 113 | 105 | 97 | 90 | 82 | 69 | 59 | 50 | ... | ... | 119 | 119 | 119 | 117 | 112 | 102 | 93 | 84 | 76 | 68 | 61 | 55 | 50 |
| 4 × 4 | 5/16 | 4.80 | 16 4 | 1 24 | 1.85 | 72 | 72 | 72 | 72 | 69 | 65 | 61 | 57 | 49 | 43 | 37 | 32 | ... | 72 | 72 | 72 | 72 | 70 | 65 | 59 | 54 | 49 | 45 | 41 | 37 | 34 |
| | 3/8 | 5.72 | 19.6 | 1.23 | 1.86 | 86 | 86 | 86 | 86 | 82 | 77 | 72 | 67 | 59 | 51 | 44 | 38 | ... | 86 | 86 | 86 | 86 | 83 | 77 | 71 | 65 | 59 | 53 | 49 | 44 | 40 |
| | 7/16 | 6.62 | 22.6 | 1.23 | 1.87 | 99 | 99 | 99 | 99 | 95 | 89 | 83 | 78 | 68 | 59 | 51 | 44 | ... | 99 | 99 | 99 | 99 | 97 | 90 | 82 | 75 | 69 | 62 | 57 | 51 | 47 |
| | 1/2 | 7.50 | 25.6 | 1.22 | 1.88 | 113 | 113 | 113 | 113 | 107 | 100 | 94 | 88 | 76 | 66 | 57 | 49 | ... | 113 | 113 | 113 | 113 | 110 | 102 | 94 | 86 | 78 | 71 | 65 | 59 | 53 |
| | 9/16 | 8.36 | 28.6 | 1.21 | 1.90 | 125 | 125 | 125 | 125 | 119 | 111 | 104 | 97 | 84 | 73 | 63 | 54 | ... | 125 | 125 | 125 | 125 | 123 | 114 | 105 | 96 | 88 | 80 | 73 | 66 | 60 |
| | 5/8 | 9.22 | 31.4 | 1 20 | 1.91 | 138 | 138 | 138 | 138 | 131 | 122 | 114 | 107 | 92 | 79 | 69 | 59 | ... | 138 | 138 | 138 | 138 | 136 | 126 | 116 | 106 | 97 | 88 | 81 | 73 | 67 |
| 6 × 6 | 3/8 | 8.72 | 29.8 | 1.88 | 2.66 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 128 | 118 | 109 | 99 | 91 | 82 | 131 | 131 | 131 | 131 | 131 | 131 | 129 | 122 | 115 | 108 | 102 | 95 | 89 |
| | 7/16 | 10.12 | 34.4 | 1.87 | 2 67 | 152 | 152 | 152 | 152 | 152 | 152 | 152 | 148 | 137 | 126 | 115 | 105 | 95 | 152 | 152 | 152 | 152 | 152 | 152 | 149 | 141 | 133 | 126 | 118 | 111 | 103 |
| | 1/2 | 11.50 | 39.2 | 1.86 | 2.68 | 173 | 173 | 173 | 173 | 173 | 173 | 173 | 168 | 155 | 143 | 130 | 118 | 108 | 172 | 172 | 172 | 172 | 172 | 172 | 170 | 161 | 152 | 143 | 134 | 126 | 118 |
| | 9/16 | 12.86 | 43.8 | 1.85 | 2.70 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 188 | 173 | 159 | 145 | 132 | 120 | 193 | 193 | 193 | 193 | 193 | 193 | 190 | 181 | 171 | 161 | 151 | 142 | 133 |
| | 5/8 | 14.22 | 48 4 | 1.84 | 2 71 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 207 | 191 | 175 | 160 | 145 | 132 | 213 | 213 | 213 | 213 | 213 | 213 | 211 | 200 | 189 | 178 | 168 | 158 | 148 |
| | 11/16 | 15.56 | 53.0 | 1.83 | 2.71 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 226 | 208 | 191 | 174 | 158 | 143 | 233 | 233 | 233 | 233 | 233 | 233 | 231 | 219 | 207 | 195 | 183 | 172 | 161 |
| | 3/4 | 16.88 | 57.4 | 1.83 | 2.73 | 253 | 253 | 253 | 253 | 253 | 253 | 253 | 245 | 226 | 207 | 189 | 171 | 156 | 253 | 253 | 253 | 253 | 253 | 253 | 250 | 239 | 226 | 212 | 200 | 188 | 176 |
| | 13/16 | 18.18 | 62.0 | 1.82 | 2.74 | 273 | 273 | 273 | 273 | 273 | 273 | 273 | 264 | 243 | 222 | 202 | 184 | 167 | 273 | 273 | 273 | 273 | 273 | 273 | 271 | 257 | 243 | 229 | 216 | 203 | 190 |
| | 7/8 | 19.46 | 66.2 | 1.81 | 2.75 | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 282 | 259 | 237 | 216 | 196 | 177 | 292 | 292 | 292 | 292 | 292 | 292 | 290 | 276 | 261 | 246 | 232 | 218 | 204 |
| | 15/16 | 20.74 | 70.6 | 1.80 | 2.76 | 311 | 311 | 311 | 311 | 311 | 311 | 311 | 300 | 275 | 252 | 229 | 207 | 188 | 311 | 311 | 311 | 311 | 311 | 311 | 310 | 294 | 279 | 263 | 247 | 232 | 218 |
| | 1" | 22.00 | 74.8 | 1 80 | 2 77 | 330 | 330 | 330 | 330 | 330 | 330 | 330 | 318 | 292 | 267 | 243 | 220 | 199 | 330 | 330 | 330 | 330 | 330 | 330 | 329 | 313 | 296 | 279 | 263 | 247 | 232 |
| 8 × 8 | 1/2 | 15.50 | 52.8 | 2.51 | 3.50 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 233 | 223 | 211 | 198 | 185 | 232 | 232 | 232 | 232 | 232 | 232 | 232 | 232 | 230 | 221 | 212 | 203 | 194 |
| | 9/16 | 17.36 | 59.2 | 2.50 | 3.50 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 250 | 235 | 221 | 207 | | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | 257 | 247 | 238 | 227 | 217 |
| | 5/8 | 19.22 | 65.4 | 2.49 | 3.51 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 276 | 260 | 244 | 228 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 285 | 275 | 264 | 252 | 240 |
| | 11/16 | 21.06 | 71.6 | 2.48 | 3.52 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 302 | 284 | 267 | 249 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 316 | 313 | 301 | 289 | 276 | 264 |
| | 3/4 | 22.88 | 77.8 | 2.47 | 3.54 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 328 | 308 | 289 | 270 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 343 | 341 | 328 | 315 | 301 | 288 |
| | 13/16 | 24.68 | 84.0 | 2.46 | 3.54 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 353 | 332 | 311 | 291 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 368 | 354 | 339 | 325 | 310 |
| | 7/8 | 26.46 | 90.0 | 2.45 | 3.55 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 378 | 355 | 333 | 311 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 397 | 395 | 380 | 364 | 349 | 333 |
| | 15/16 | 28.24 | 96.2 | 2.44 | 3.56 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 402 | 378 | 354 | 331 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 422 | 406 | 389 | 373 | 356 |
| | 1" | 30.00 | 102.0 | 2.44 | 3.58 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 428 | 402 | 376 | 351 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 449 | 432 | 415 | 397 | 380 |
| | 1 1/16 | 31.74 | 108.0 | 2.43 | 3.59 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 451 | 424 | 397 | 370 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 476 | 458 | 439 | 421 | 402 |
| | 1⅛ | 33.46 | 113.8 | 2.42 | 3.60 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 475 | 446 | 417 | 389 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 502 | 483 | 464 | 444 | 425 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO UNEQUAL ANGLES

SHORT LEGS BACK TO BACK

Loads to right of heavy vertical lines are for Secondary Members ONLY.

| Size | Thickness | Two Angles | | Radius of Gyration | | AXIS X - X Unsupported Length in Feet | | | | | | | | | | AXIS Y - Y Unsupported Length in Feet | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | Weight | X-X | Y-Y | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| 2½ × 2 | 3/16 | 1.62 | 5.5 | .60 | 1.24 | 24 | 22 | 19 | 16 | 14 | 12 | 10 | 9 | ... | ... | ... | 24 | 23 | 22 | 21 | 19 | 17 | 14 | 13 | 11 | 9 | | | | | |
| | 1/4 | 2.12 | 7.2 | .59 | 1.25 | 32 | 28 | 24 | 21 | 18 | 15 | 13 | ... | ... | ... | ... | 32 | 30 | 29 | 27 | 25 | 22 | 19 | 17 | 14 | 13 | | | | | |
| | 5/16 | 2 62 | 9.0 | .58 | 1 26 | 39 | 34 | 30 | 25 | 22 | 19 | 16 | ... | ... | ... | ... | 39 | 38 | 36 | 33 | 31 | 27 | 24 | 21 | 18 | 16 | | | | | |
| 3 × 2½ | 1/4 | 2.62 | 9.0 | .75 | 1 45 | 39 | 38 | 35 | 31 | 28 | 25 | 22 | 20 | 16 | ... | ... | 39 | 39 | 38 | 36 | 34 | 31 | 27 | 24 | 21 | 19 | 17 | 15 | | | |
| | 5/16 | 3.24 | 11.2 | .74 | 1.46 | 49 | 47 | 43 | 38 | 34 | 30 | 27 | 24 | 19 | ... | ... | 49 | 49 | 47 | 45 | 42 | 38 | 34 | 30 | 26 | 23 | 21 | 19 | | | |
| | 3/8 | 3.84 | 13.2 | .74 | 1.48 | 58 | 56 | 51 | 45 | 40 | 36 | 32 | 28 | 22 | ... | ... | 58 | 58 | 56 | 53 | 51 | 45 | 40 | 36 | 32 | 28 | 25 | 22 | | | |
| | 7/16 | 4 42 | 15 2 | .73 | 1.49 | 66 | 64 | 58 | 52 | 46 | 41 | 36 | 32 | 25 | ... | ... | 66 | 66 | 65 | 62 | 58 | 52 | 47 | 41 | 37 | 33 | 29 | 26 | | | |
| 3½ × 2½ | 1/4 | 2.88 | 9.8 | .74 | 1.71 | 43 | 42 | 38 | 34 | 30 | 27 | 24 | 21 | 17 | ... | ... | 43 | 43 | 43 | 43 | 41 | 37 | 34 | 31 | 27 | 25 | 22 | 20 | 18 | 17 | |
| | 5/16 | 3.56 | 12.2 | .73 | 1.73 | 53 | 52 | 46 | 42 | 37 | 33 | 29 | 26 | 20 | ... | ... | 53 | 53 | 53 | 53 | 51 | 46 | 42 | 38 | 34 | 31 | 28 | 25 | 23 | 21 | |
| | 3/8 | 4.22 | 14.4 | .72 | 1.74 | 63 | 61 | 55 | 49 | 43 | 38 | 34 | 30 | 24 | ... | ... | 63 | 63 | 63 | 63 | 60 | 55 | 50 | 45 | 41 | 37 | 33 | 30 | 27 | 25 | |
| | 7/16 | 4.86 | 16.6 | .71 | 1.75 | 73 | 70 | 63 | 56 | 49 | 43 | 38 | 34 | ... | ... | ... | 73 | 73 | 73 | 72 | 69 | 64 | 58 | 52 | 47 | 43 | 39 | 35 | 32 | 29 | |
| | 1/2 | 5 50 | 18.8 | .70 | 1.76 | 83 | 78 | 70 | 62 | 55 | 48 | 43 | 38 | ... | ... | ... | 83 | 83 | 83 | 82 | 79 | 72 | 66 | 60 | 54 | 49 | 44 | 40 | 36 | 33 | |
| 4 × 3 | 5/16 | 4.18 | 14.4 | .89 | 1.93 | 63 | 63 | 60 | 55 | 51 | 46 | 42 | 37 | 31 | 25 | ... | 63 | 63 | 63 | 63 | 62 | 57 | 53 | 49 | 44 | 41 | 37 | 34 | 31 | 28 | |
| | 3/8 | 4.96 | 17.0 | .88 | 1.94 | 74 | 74 | 71 | 65 | 60 | 54 | 49 | 44 | 36 | 30 | ... | 74 | 74 | 74 | 74 | 73 | 68 | 63 | 58 | 53 | 48 | 44 | 40 | 37 | 33 | |
| | 7/16 | 5.74 | 19.6 | .87 | 1.95 | 86 | 86 | 82 | 75 | 68 | 62 | 56 | 50 | 41 | 34 | ... | 86 | 86 | 86 | 86 | 85 | 79 | 73 | 67 | 61 | 56 | 51 | 47 | 43 | 39 | 36 |
| | 1/2 | 6.50 | 22.2 | .86 | 1.96 | 98 | 98 | 92 | 84 | 76 | 69 | 62 | 56 | 46 | 38 | ... | 98 | 98 | 98 | 98 | 97 | 90 | 83 | 76 | 70 | 64 | 58 | 53 | 49 | 44 | 41 |
| | 9/16 | 7.24 | 24.8 | .86 | 1 97 | 109 | 109 | 103 | 94 | 85 | 77 | 69 | 63 | 51 | 42 | ... | 109 | 109 | 109 | 109 | 108 | 100 | 93 | 85 | 78 | 71 | 65 | 60 | 54 | 50 | 46 |
| | 5/8 | 7.96 | 27 2 | .85 | 1 98 | 119 | 119 | 112 | 102 | 93 | 84 | 75 | 68 | 55 | 45 | ... | 119 | 119 | 119 | 119 | 119 | 111 | 102 | 94 | 86 | 79 | 72 | 66 | 60 | 55 | 51 |
| 4 × 3½ | 5/16 | 4.50 | 15.4 | 1.07 | 1.86 | 68 | 68 | 68 | 65 | 60 | 56 | 52 | 48 | 40 | 34 | 29 | 68 | 68 | 68 | 68 | 66 | 61 | 56 | 51 | 46 | 42 | 38 | 35 | 32 | 29 | |
| | 3/8 | 5.34 | 18.2 | 1.06 | 1.88 | 80 | 80 | 80 | 76 | 71 | 66 | 61 | 56 | 47 | 40 | 34 | 80 | 80 | 80 | 80 | 78 | 73 | 67 | 61 | 55 | 50 | 46 | 42 | 38 | 35 | |
| | 7/16 | 6.18 | 21.2 | 1.05 | 1.88 | 93 | 93 | 93 | 88 | 82 | 76 | 70 | 64 | 54 | 46 | 39 | 93 | 93 | 93 | 93 | 91 | 84 | 77 | 70 | 64 | 58 | 53 | 48 | 44 | 40 | |
| | 1/2 | 7.00 | 23.8 | 1.04 | 1.89 | 105 | 105 | 105 | 100 | 92 | 86 | 79 | 72 | 61 | 51 | 44 | 105 | 105 | 105 | 105 | 103 | 95 | 88 | 80 | 73 | 66 | 60 | 55 | 50 | 46 | |
| | 9/16 | 7.80 | 26.6 | 1.03 | 1.90 | 117 | 117 | 117 | 110 | 102 | 95 | 87 | 80 | 67 | 57 | 48 | 117 | 117 | 117 | 117 | 115 | 106 | 98 | 90 | 82 | 74 | 68 | 62 | 56 | 51 | |
| | 5/8 | 8.60 | 29.4 | 1.02 | 1.91 | 129 | 129 | 129 | 121 | 112 | 104 | 95 | 88 | 73 | 62 | 52 | 129 | 129 | 129 | 129 | 127 | 118 | 108 | 99 | 91 | 82 | 75 | 68 | 62 | 57 | |
| | 11/16 | 9.36 | 32.0 | 1.02 | 1.93 | 140 | 140 | 140 | 132 | 122 | 113 | 104 | 95 | 80 | 67 | 57 | 140 | 140 | 140 | 140 | 139 | 129 | 119 | 109 | 99 | 91 | 83 | 75 | 69 | 63 | |
| | 3/4 | 10.12 | 34.6 | 1.01 | 1.94 | 152 | 152 | 152 | 142 | 132 | 121 | 111 | 102 | 86 | 72 | 61 | 152 | 152 | 152 | 152 | 150 | 139 | 129 | 118 | 108 | 98 | 90 | 82 | 75 | 68 | |
| 5 × 3 | 5/16 | 4.80 | 16.4 | .85 | 2.47 | 72 | 72 | 67 | 62 | 56 | 51 | 46 | 41 | 33 | 27 | ... | 72 | 72 | 72 | 72 | 72 | 72 | 69 | 65 | 61 | 57 | 53 | 49 | 46 | 43 | 40 |
| | 3/8 | 5.72 | 19.6 | .84 | 2.48 | 86 | 86 | 80 | 73 | 66 | 60 | 53 | 48 | 39 | 32 | ... | 86 | 86 | 86 | 86 | 86 | 86 | 82 | 77 | 72 | 68 | 63 | 59 | 55 | 51 | 47 |
| | 7/16 | 6.62 | 22.6 | .84 | 2.49 | 99 | 99 | 93 | 85 | 77 | 69 | 62 | 56 | 45 | 37 | ... | 99 | 99 | 99 | 99 | 99 | 99 | 95 | 90 | 84 | 79 | 73 | 68 | 64 | 59 | 55 |
| | 1/2 | 7.50 | 25.6 | .83 | 2.50 | 113 | 113 | 105 | 95 | 86 | 77 | 70 | 62 | 50 | ... | ... | 113 | 113 | 113 | 113 | 113 | 113 | 108 | 102 | 95 | 89 | 83 | 78 | 72 | 67 | 63 |
| | 9/16 | 8.36 | 28.6 | .82 | 2.52 | 125 | 125 | 116 | 105 | 95 | 85 | 77 | 69 | 55 | ... | ... | 125 | 125 | 125 | 125 | 125 | 125 | 121 | 114 | 107 | 100 | 93 | 87 | 81 | 76 | 70 |
| | 5/8 | 9.22 | 31.4 | .82 | 2.53 | 138 | 138 | 128 | 116 | 105 | 94 | 85 | 76 | 61 | ... | ... | 138 | 138 | 138 | 138 | 138 | 138 | 133 | 126 | 118 | 111 | 103 | 97 | 90 | 84 | 78 |
| | 11/16 | 10.06 | 34.2 | .81 | 2.54 | 151 | 151 | 139 | 126 | 113 | 102 | 91 | 82 | 66 | ... | ... | 151 | 151 | 151 | 151 | 151 | 151 | 146 | 137 | 129 | 121 | 113 | 106 | 98 | 92 | 86 |
| | 3/4 | 10.88 | 37.0 | .80 | 2.55 | 163 | 163 | 149 | 135 | 121 | 109 | 97 | 87 | 70 | ... | ... | 163 | 163 | 163 | 163 | 163 | 163 | 158 | 150 | 140 | 131 | 123 | 115 | 107 | 100 | 93 |
| 5 × 3½ | 5/16 | 5.12 | 17.4 | 1.03 | 2.39 | 77 | 77 | 77 | 72 | 67 | 62 | 57 | 52 | 44 | 37 | 31 | 77 | 77 | 77 | 77 | 77 | 77 | 72 | 68 | 63 | 59 | 55 | 51 | 47 | 44 | 41 |
| | 3/8 | 6.10 | 20.8 | 1.02 | 2.40 | 91 | 91 | 91 | 86 | 80 | 74 | 68 | 62 | 52 | 44 | 37 | 92 | 92 | 92 | 92 | 92 | 92 | 86 | 81 | 76 | 71 | 66 | 61 | 57 | 53 | 49 |
| | 7/16 | 7.06 | 24.0 | 1.01 | 2.41 | 106 | 106 | 106 | 99 | 92 | 85 | 78 | 71 | 60 | 50 | 42 | 106 | 106 | 106 | 106 | 106 | 106 | 100 | 94 | 88 | 82 | 76 | 71 | 66 | 61 | 57 |
| | 1/2 | 8.00 | 27.2 | 1.01 | 2.43 | 120 | 120 | 120 | 112 | 104 | 96 | 88 | 81 | 67 | 56 | 48 | 120 | 120 | 120 | 120 | 120 | 120 | 114 | 107 | 100 | 93 | 87 | 81 | 75 | 70 | 65 |
| | 9/16 | 8.94 | 30.4 | 1.00 | 2.44 | 134 | 134 | 134 | 125 | 116 | 106 | 98 | 89 | 75 | 63 | 53 | 134 | 134 | 134 | 134 | 134 | 134 | 127 | 120 | 112 | 105 | 98 | 91 | 84 | 78 | 73 |
| | 5/8 | 9.84 | 33.6 | .99 | 2.45 | 148 | 148 | 148 | 137 | 127 | 116 | 107 | 98 | 81 | 68 | 57 | 148 | 148 | 148 | 148 | 148 | 148 | 140 | 132 | 124 | 116 | 108 | 100 | 93 | 87 | 80 |
| | 11/16 | 10.74 | 36.6 | .98 | 2.46 | 161 | 161 | 160 | 149 | 137 | 126 | 115 | 105 | 88 | 73 | 62 | 161 | 161 | 161 | 161 | 161 | 161 | 154 | 144 | 135 | 126 | 118 | 110 | 102 | 95 | 88 |
| | 3/4 | 11.62 | 39.6 | .98 | 2 48 | 174 | 174 | 173 | 161 | 149 | 136 | 125 | 114 | 95 | 79 | 67 | 174 | 174 | 174 | 174 | 174 | 174 | 167 | 157 | 147 | 138 | 128 | 120 | 111 | 104 | 96 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO UNEQUAL ANGLES

SHORT LEGS BACK TO BACK

Loads to right of heavy vertical lines are for Secondary Members ONLY.

3/8" BACK TO BACK

| Size | Thickness | Two Angles Area | Two Angles Weight | Radius of Gyration X-X | Radius of Gyration Y-Y | AXIS X - X Unsupported Length in Feet 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | AXIS Y - Y Unsupported Length in Feet 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 × 3½ | 3/8 | 6.84 | 23.4 | .99 | 2.95 | 103 | 102 | 95 | 88 | 81 | 74 | 68 | 57 | 47 | 40 | ... | ... | 103 | 100 | 95 | 90 | 85 | 81 | 76 | 72 | 67 | 63 | 60 | 56 | 53 | 50 |
| | 7/16 | 7.94 | 27.0 | .98 | 2.96 | 119 | 118 | 110 | 102 | 93 | 85 | 78 | 65 | 54 | 46 | ... | ... | 119 | 116 | 110 | 105 | 99 | 94 | 88 | 83 | 78 | 74 | 70 | 65 | 62 | 58 |
| | 1/2 | 9.00 | 30.6 | .97 | 2.97 | 135 | 133 | 124 | 114 | 105 | 98 | 87 | 73 | 61 | 51 | ... | ... | 135 | 131 | 125 | 119 | 113 | 106 | 100 | 95 | 89 | 84 | 79 | 74 | 70 | 66 |
| | 9/16 | 10.06 | 34.2 | .96 | 2.99 | 151 | 149 | 138 | 127 | 116 | 106 | 97 | 80 | 67 | 56 | ... | ... | 151 | 147 | 140 | 133 | 126 | 119 | 113 | 106 | 100 | 94 | 89 | 84 | 79 | 74 |
| | 5/8 | 11.10 | 37.8 | .96 | 3.00 | 167 | 164 | 152 | 140 | 128 | 117 | 107 | 89 | 74 | 62 | ... | ... | 167 | 163 | 155 | 147 | 140 | 132 | 125 | 118 | 111 | 105 | 99 | 93 | 87 | 82 |
| | 11/16 | 12.12 | 41.2 | .95 | 3.01 | 182 | 179 | 165 | 152 | 139 | 127 | 116 | 96 | 80 | ... | ... | ... | 182 | 178 | 170 | 161 | 153 | 145 | 137 | 129 | 122 | 115 | 108 | 102 | 96 | 90 |
| | 3/4 | 13.12 | 44.8 | .94 | 3.03 | 197 | 193 | 178 | 164 | 149 | 136 | 124 | 102 | 85 | ... | ... | ... | 197 | 193 | 184 | 175 | 166 | 157 | 149 | 140 | 132 | 125 | 118 | 111 | 105 | 99 |
| | 13/16 | 14.12 | 48.0 | .94 | 3.04 | 212 | 207 | 192 | 176 | 161 | 147 | 133 | 110 | 92 | ... | ... | ... | 212 | 208 | 199 | 189 | 179 | 169 | 160 | 152 | 143 | 135 | 127 | 120 | 113 | 107 |
| | 7/8 | 15.10 | 51.4 | .93 | 3.05 | 227 | 221 | 204 | 187 | 171 | 155 | 141 | 117 | 97 | ... | ... | ... | 227 | 223 | 213 | 202 | 192 | 182 | 172 | 162 | 153 | 145 | 136 | 129 | 121 | 114 |
| 6 × 4 | 3/8 | 7.22 | 24.6 | 1.17 | 2.87 | 108 | 108 | 107 | 101 | 95 | 88 | 82 | 71 | 60 | 52 | 45 | ... | 108 | 104 | 99 | 94 | 88 | 83 | 78 | 74 | 69 | 65 | 61 | 58 | 54 | 51 |
| | 7/16 | 8.36 | 28.6 | 1.16 | 2.88 | 125 | 125 | 124 | 117 | 109 | 102 | 95 | 81 | 69 | 59 | 50 | ... | 125 | 121 | 115 | 109 | 103 | 97 | 91 | 86 | 81 | 76 | 71 | 67 | 63 | 59 |
| | 1/2 | 9.50 | 32.4 | 1.15 | 2.90 | 142 | 142 | 140 | 132 | 124 | 115 | 107 | 92 | 78 | 67 | 58 | ... | 143 | 138 | 131 | 124 | 117 | 110 | 104 | 98 | 92 | 87 | 81 | 77 | 72 | 68 |
| | 9/16 | 10.62 | 36.2 | 1.14 | 2.91 | 159 | 159 | 157 | 147 | 137 | 127 | 119 | 102 | 87 | 74 | 64 | ... | 159 | 154 | 146 | 139 | 131 | 124 | 117 | 110 | 103 | 97 | 91 | 86 | 81 | 76 |
| | 5/8 | 11.72 | 40.0 | 1.13 | 2.92 | 176 | 176 | 172 | 162 | 150 | 139 | 130 | 111 | 94 | 81 | 70 | ... | 176 | 170 | 162 | 153 | 145 | 137 | 129 | 122 | 114 | 108 | 101 | 95 | 90 | 84 |
| | 11/16 | 12.80 | 43.6 | 1.13 | 2.94 | 192 | 192 | 188 | 176 | 164 | 153 | 142 | 121 | 103 | 88 | 76 | ... | 192 | 186 | 177 | 168 | 159 | 150 | 142 | 134 | 126 | 118 | 111 | 105 | 99 | 93 |
| | 3/4 | 13.88 | 47.2 | 1.12 | 2.95 | 208 | 208 | 203 | 190 | 177 | 165 | 153 | 130 | 111 | 95 | 81 | ... | 208 | 202 | 193 | 183 | 173 | 163 | 154 | 145 | 137 | 129 | 121 | 114 | 107 | 101 |
| | 13/16 | 14.94 | 50.8 | 1.11 | 2.96 | 224 | 224 | 218 | 204 | 190 | 176 | 163 | 139 | 118 | 101 | 87 | ... | 224 | 218 | 208 | 197 | 186 | 176 | 166 | 157 | 148 | 139 | 131 | 123 | 116 | 109 |
| | 7/8 | 15.96 | 54.4 | 1.11 | 2.97 | 239 | 239 | 233 | 218 | 203 | 188 | 174 | 148 | 126 | 108 | 93 | ... | 239 | 233 | 222 | 211 | 200 | 189 | 178 | 168 | 158 | 149 | 140 | 132 | 124 | 117 |
| 7 × 3½ | 3/8 | 7.60 | 26.0 | .96 | 3.50 | 114 | 112 | 104 | 96 | 88 | 80 | 73 | 61 | 51 | 42 | ... | ... | 114 | 114 | 113 | 108 | 104 | 99 | 95 | 91 | 86 | 82 | 78 | 74 | 70 | 67 |
| | 7/16 | 8.80 | 30.0 | .95 | 3.51 | 132 | 130 | 120 | 111 | 101 | 92 | 84 | 69 | 58 | ... | ... | ... | 132 | 132 | 131 | 126 | 120 | 115 | 110 | 105 | 100 | 95 | 90 | 86 | 82 | 78 |
| | 1/2 | 10.00 | 34.0 | .94 | 3.53 | 150 | 147 | 135 | 125 | 114 | 104 | 94 | 78 | 65 | ... | ... | ... | 150 | 150 | 149 | 143 | 137 | 131 | 126 | 120 | 114 | 109 | 103 | 98 | 93 | 89 |
| | 9/16 | 11.18 | 38.2 | .93 | 3.54 | 168 | 163 | 151 | 139 | 126 | 115 | 105 | 86 | 72 | ... | ... | ... | 168 | 168 | 167 | 160 | 154 | 147 | 141 | 134 | 128 | 122 | 116 | 110 | 105 | 100 |
| | 5/8 | 12.34 | 42.0 | .93 | 3.55 | 185 | 180 | 167 | 153 | 140 | 127 | 115 | 95 | 79 | ... | ... | ... | 185 | 185 | 184 | 177 | 170 | 163 | 155 | 148 | 141 | 135 | 128 | 122 | 116 | 110 |
| | 11/16 | 13.50 | 46.0 | .92 | 3.57 | 203 | 197 | 181 | 166 | 152 | 138 | 125 | 103 | 85 | ... | ... | ... | 203 | 203 | 202 | 194 | 186 | 178 | 171 | 163 | 155 | 148 | 141 | 134 | 127 | 121 |
| | 3/4 | 14.62 | 49.8 | .91 | 3.58 | 219 | 212 | 195 | 179 | 163 | 148 | 134 | 110 | 91 | ... | ... | ... | 219 | 219 | 219 | 211 | 202 | 194 | 185 | 177 | 169 | 161 | 153 | 145 | 138 | 132 |
| | 13/16 | 15.74 | 53.6 | .91 | 3.59 | 236 | 228 | 210 | 192 | 175 | 159 | 144 | 119 | 98 | ... | ... | ... | 236 | 236 | 236 | 227 | 218 | 209 | 200 | 190 | 182 | 173 | 165 | 157 | 149 | 142 |
| | 7/8 | 16.84 | 57.4 | .90 | 3.60 | 253 | 243 | 224 | 204 | 186 | 168 | 153 | 125 | 103 | ... | ... | ... | 253 | 253 | 253 | 243 | 233 | 224 | 214 | 204 | 195 | 186 | 177 | 168 | 160 | 153 |
| | 15/16 | 17.94 | 61.0 | .89 | 3.62 | 269 | 258 | 237 | 216 | 196 | 178 | 161 | 132 | 108 | ... | ... | ... | 269 | 269 | 269 | 260 | 249 | 239 | 229 | 218 | 208 | 199 | 189 | 180 | 172 | 163 |
| | 1" | 19.00 | 64.6 | .89 | 3.63 | 285 | 273 | 251 | 229 | 208 | 188 | 170 | 139 | 115 | ... | ... | ... | 285 | 285 | 285 | 275 | 264 | 253 | 242 | 232 | 221 | 211 | 201 | 191 | 182 | 173 |
| 8 × 6 | 7/16 | 11.86 | 40.4 | 1.80 | 3.68 | 178 | 178 | 178 | 178 | 178 | 178 | 171 | 158 | 144 | 130 | 119 | 108 | 178 | 178 | 178 | 173 | 166 | 159 | 153 | 146 | 139 | 133 | 127 | 121 | 115 | 110 |
| | 1/2 | 13.50 | 46.0 | 1.79 | 3.69 | 202 | 202 | 202 | 202 | 202 | 202 | 195 | 179 | 163 | 148 | 134 | 122 | 203 | 203 | 203 | 197 | 189 | 182 | 174 | 166 | 159 | 152 | 145 | 138 | 131 | 125 |
| | 9/16 | 15.12 | 51.4 | 1.78 | 3.71 | 227 | 227 | 227 | 227 | 227 | 226 | 217 | 200 | 182 | 165 | 150 | 135 | 227 | 227 | 227 | 221 | 212 | 204 | 195 | 187 | 179 | 171 | 163 | 155 | 148 | 141 |
| | 5/8 | 16.72 | 57.0 | 1.77 | 3.71 | 251 | 251 | 251 | 251 | 251 | 249 | 239 | 221 | 200 | 183 | 165 | 148 | 251 | 251 | 251 | 244 | 235 | 226 | 216 | 207 | 198 | 189 | 180 | 172 | 164 | 156 |
| | 11/16 | 18.30 | 62.4 | 1.77 | 3.72 | 275 | 275 | 275 | 275 | 275 | 273 | 262 | 241 | 219 | 199 | 180 | 163 | 275 | 275 | 275 | 268 | 257 | 247 | 237 | 227 | 217 | 207 | 197 | 188 | 180 | 171 |
| | 3/4 | 19.88 | 67.6 | 1.76 | 3.73 | 298 | 298 | 298 | 298 | 298 | 297 | 285 | 260 | 238 | 215 | 194 | 177 | 298 | 298 | 298 | 291 | 280 | 269 | 258 | 247 | 236 | 225 | 215 | 205 | 195 | 186 |
| | 13/16 | 21.44 | 73.0 | 1.75 | 3.75 | 322 | 322 | 322 | 322 | 322 | 319 | 306 | 280 | 255 | 231 | 209 | 189 | 322 | 322 | 322 | 314 | 303 | 291 | 279 | 267 | 255 | 244 | 233 | 222 | 212 | 202 |
| | 7/8 | 22.96 | 78.2 | 1.74 | 3.76 | 344 | 344 | 344 | 344 | 344 | 340 | 327 | 299 | 272 | 247 | 223 | 201 | 344 | 344 | 344 | 337 | 324 | 312 | 299 | 286 | 274 | 262 | 250 | 238 | 227 | 217 |
| | 15/16 | 24.50 | 83.4 | 1.73 | 3.77 | 368 | 368 | 368 | 368 | 368 | 363 | 348 | 319 | 289 | 262 | 236 | 213 | 368 | 368 | 368 | 360 | 347 | 333 | 319 | 306 | 293 | 280 | 267 | 255 | 243 | 232 |
| | 1" | 26.00 | 88.4 | 1.73 | 3.78 | 390 | 390 | 390 | 390 | 390 | 385 | 369 | 338 | 307 | 278 | 251 | 226 | 390 | 390 | 390 | 382 | 368 | 354 | 340 | 325 | 311 | 297 | 284 | 271 | 259 | 247 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO UNEQUAL ANGLES

LONG LEGS BACK TO BACK

Loads to right of heavy vertical lines are for Secondary Members ONLY.

3/8" BACK TO BACK

| Size | Thickness | Two Angles | | Radius of Gyration | | AXIS X - X Unsupported Length in Feet | | | | | | | | | | | | AXIS Y - Y Unsupported Length in Feet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | Weight | X-X | Y-Y | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
| 2½ × 2 | 3/16 | 1.62 | 5.5 | .79 | .92 | 24 | 22 | 20 | 18 | 16 | 14 | 13 | 10 | ... | ... | ... | ... | ... | 24 | 24 | 22 | 20 | 18 | 17 | 15 | 12 | 10 | | | | |
| | 1/4 | 2.12 | 7.2 | .78 | .93 | 32 | 29 | 26 | 23 | 21 | 19 | 17 | 13 | ... | ... | ... | ... | ... | 32 | 31 | 29 | 26 | 24 | 22 | 20 | 16 | 14 | | | | |
| | 5/16 | 2 62 | 9 0 | .78 | .95 | 39 | 36 | 32 | 29 | 26 | 23 | 20 | 16 | ... | ... | ... | ... | ... | 39 | 39 | 36 | 33 | 30 | 27 | 25 | 21 | 17 | | | | |
| 3 × 2½ | 1/4 | 2.62 | 9.0 | .95 | 1.13 | 39 | 39 | 36 | 33 | 30 | 28 | 25 | 20 | 17 | ... | ... | ... | ... | 39 | 39 | 38 | 36 | 34 | 31 | 29 | 25 | 21 | 18 | 16 | | |
| | 5/16 | 3.24 | 11.2 | 94 | 1.14 | 49 | 48 | 44 | 40 | 37 | 34 | 31 | 25 | 21 | ... | ... | ... | ... | 49 | 49 | 48 | 45 | 42 | 39 | 36 | 31 | 26 | 23 | 19 | | |
| | 3/8 | 3.84 | 13 2 | .93 | 1.16 | 58 | 56 | 52 | 48 | 43 | 40 | 36 | 30 | 25 | ... | ... | ... | ... | 58 | 58 | 57 | 53 | 50 | 47 | 43 | 37 | 32 | 27 | 24 | | |
| | 7/16 | 4 42 | 15.2 | .92 | 1 17 | 66 | 64 | 59 | 54 | 50 | 45 | 41 | 34 | 28 | ... | ... | ... | ... | 66 | 66 | 66 | 62 | 58 | 54 | 50 | 43 | 37 | 32 | 27 | | |
| 3½ × 2½ | 1/4 | 2.88 | 9.8 | 1 12 | 1.09 | 43 | 43 | 42 | 39 | 37 | 34 | 32 | 27 | 23 | 20 | 17 | ... | ... | 43 | 43 | 42 | 39 | 36 | 34 | 31 | 26 | 22 | 19 | 16 | | |
| | 5/16 | 3 56 | 12.2 | 1 11 | 1.10 | 53 | 53 | 52 | 49 | 45 | 42 | 39 | 33 | 28 | 24 | 21 | ... | ... | 53 | 53 | 52 | 48 | 45 | 42 | 39 | 33 | 28 | 24 | 20 | | |
| | 3/8 | 4 22 | 14.4 | 1 10 | 1.11 | 63 | 63 | 61 | 57 | 53 | 50 | 46 | 39 | 33 | 28 | 24 | .. | ... | 63 | 63 | 62 | 58 | 54 | 50 | 46 | 39 | 33 | 29 | 24 | | |
| | 7/16 | 4 86 | 16 6 | 1.09 | 1.12 | 73 | 73 | 70 | 66 | 61 | 57 | 52 | 44 | 38 | 32 | 26 | ... | ... | 73 | 73 | 71 | 67 | 62 | 58 | 53 | 46 | 39 | 33 | 29 | | |
| | 1/2 | 5 50 | 18 8 | 1 09 | 1 13 | 83 | 83 | 80 | 75 | 69 | 64 | 59 | 50 | 43 | 36 | 31 | ... | ... | 83 | 83 | 81 | 76 | 71 | 66 | 61 | 52 | 44 | 38 | 33 | | |
| 4 × 3 | 5/16 | 4.18 | 14.4 | 1 27 | 1 30 | 63 | 63 | 63 | 61 | 57 | 54 | 50 | 44 | 38 | 33 | 29 | 25 | ... | 63 | 63 | 63 | 61 | 58 | 54 | 51 | 45 | 39 | 34 | 30 | 26 | |
| | 3/8 | 4.96 | 17.0 | 1.26 | 1.31 | 74 | 74 | 74 | 72 | 68 | 63 | 59 | 52 | 45 | 39 | 34 | 30 | ... | 74 | 74 | 74 | 73 | 69 | 65 | 61 | 53 | 47 | 41 | 36 | 31 | |
| | 7/16 | 5.74 | 19 6 | 1.25 | 1.32 | 86 | 86 | 86 | 83 | 78 | 73 | 68 | 60 | 52 | 45 | 39 | 34 | ... | 86 | 86 | 86 | 84 | 80 | 75 | 71 | 62 | 54 | 47 | 42 | 36 | 32 |
| | 1/2 | 6.50 | 22.2 | 1 25 | 1.33 | 98 | 98 | 98 | 94 | 88 | 83 | 77 | 67 | 58 | 51 | 44 | 38 | ... | 98 | 98 | 98 | 96 | 91 | 86 | 81 | 71 | 62 | 54 | 47 | 42 | 37 |
| | 9/16 | 7.24 | 24.8 | 1.24 | 1 35 | 109 | 109 | 109 | 104 | 98 | 92 | 86 | 75 | 65 | 56 | 49 | 42 | ... | 109 | 109 | 109 | 107 | 102 | 96 | 91 | 80 | 70 | 61 | 54 | 47 | 42 |
| | 5/8 | 7.96 | 27 2 | 1.23 | 1 36 | 119 | 119 | 119 | 114 | 107 | 100 | 94 | 81 | 70 | 61 | 53 | 46 | ... | 119 | 119 | 119 | 118 | 112 | 106 | 100 | 88 | 78 | 68 | 60 | 52 | 46 |
| 4 × 3½ | 5/16 | 4.50 | 15 4 | 1.26 | 1 55 | 68 | 68 | 68 | 65 | 61 | 58 | 54 | 47 | 41 | 35 | 31 | 27 | ... | 68 | 68 | 68 | 68 | 67 | 64 | 61 | 55 | 49 | 44 | 39 | 35 | 31 |
| | 3/8 | 5.34 | 18.2 | 1 25 | 1.56 | 80 | 80 | 80 | 77 | 72 | 68 | 64 | 55 | 48 | 42 | 36 | 32 | ... | 80 | 80 | 80 | 80 | 79 | 76 | 72 | 65 | 58 | 52 | 47 | 41 | 37 |
| | 7/16 | 6.18 | 21.2 | 1.24 | 1.57 | 93 | 93 | 93 | 89 | 83 | 78 | 73 | 64 | 55 | 48 | 41 | 36 | ... | 93 | 93 | 93 | 93 | 92 | 88 | 84 | 76 | 68 | 61 | 54 | 48 | 43 |
| | 1/2 | 7.00 | 23.8 | 1.23 | 1.58 | 105 | 105 | 105 | 100 | 94 | 88 | 82 | 72 | 62 | 54 | 46 | 40 | ... | 105 | 105 | 105 | 105 | 105 | 100 | 95 | 86 | 77 | 69 | 62 | 55 | 49 |
| | 9/16 | 7.80 | 26.6 | 1.23 | 1.59 | 117 | 117 | 117 | 112 | 105 | 98 | 92 | 80 | 69 | 60 | 52 | 45 | ... | 117 | 117 | 117 | 117 | 117 | 112 | 107 | 96 | 87 | 78 | 69 | 62 | 55 |
| | 5/8 | 8.60 | 29.4 | 1.22 | 1.60 | 129 | 129 | 129 | 123 | 115 | 108 | 101 | 87 | 75 | 65 | 56 | 49 | ... | 129 | 129 | 129 | 129 | 129 | 123 | 118 | 107 | 96 | 86 | 77 | 69 | 62 |
| | 11/16 | 9 36 | 32.0 | 1 21 | 1 62 | 140 | 140 | 140 | 133 | 125 | 117 | 109 | 94 | 81 | 70 | 61 | 53 | ... | 140 | 140 | 140 | 140 | 140 | 135 | 129 | 117 | 105 | 95 | 85 | 76 | 68 |
| | 3/4 | 10 12 | 34 6 | 1.20 | 1 63 | 152 | 152 | 152 | 143 | 134 | 126 | 117 | 101 | 87 | 75 | 65 | 57 | ... | 152 | 152 | 152 | 152 | 152 | 146 | 140 | 127 | 115 | 103 | 92 | 83 | 74 |
| 5 × 3 | 5/16 | 4.80 | 16.4 | 1.61 | 1.22 | 72 | 72 | 72 | 72 | 72 | 69 | 66 | 60 | 54 | 48 | 43 | 39 | 35 | 72 | 72 | 72 | 68 | 64 | 60 | 56 | 49 | 42 | 36 | 32 | 27 | |
| | 3/8 | 5.72 | 19.6 | 1 61 | 1.23 | 86 | 86 | 86 | 86 | 86 | 82 | 79 | 71 | 64 | 57 | 51 | 46 | 41 | 86 | 86 | 86 | 82 | 77 | 72 | 67 | 59 | 51 | 44 | 38 | 33 | |
| | 7/16 | 6.62 | 22 6 | 1.60 | 1.24 | 99 | 99 | 99 | 99 | 99 | 95 | 91 | 82 | 74 | 66 | 59 | 53 | 47 | 99 | 99 | 99 | 95 | 89 | 84 | 78 | 68 | 59 | 51 | 44 | 39 | |
| | 1/2 | 7.50 | 25.6 | 1.59 | 1 25 | 113 | 113 | 113 | 113 | 112 | 107 | 103 | 93 | 83 | 75 | 67 | 60 | 53 | 113 | 113 | 113 | 108 | 102 | 95 | 89 | 78 | 67 | 58 | 51 | 44 | |
| | 9/16 | 8 36 | 28.6 | 1.58 | 1.26 | 125 | 125 | 125 | 125 | 125 | 119 | 114 | 103 | 92 | 83 | 74 | 66 | 59 | 125 | 125 | 125 | 121 | 114 | 107 | 100 | 87 | 76 | 66 | 57 | 50 | |
| | 5/8 | 9.22 | 31.4 | 1.57 | 1.28 | 138 | 138 | 138 | 138 | 137 | 131 | 125 | 113 | 101 | 91 | 81 | 72 | 64 | 138 | 138 | 138 | 134 | 126 | 119 | 112 | 98 | 85 | 74 | 64 | 56 | |
| | 11/16 | 10.06 | 34.2 | 1.56 | 1 29 | 151 | 151 | 151 | 151 | 150 | 143 | 136 | 123 | 110 | 98 | 88 | 78 | 70 | 151 | 151 | 151 | 147 | 138 | 130 | 122 | 107 | 93 | 81 | 71 | 62 | |
| | 3/4 | 10 88 | 37.0 | 1 55 | 1.31 | 163 | 163 | 163 | 163 | 161 | 154 | 147 | 132 | 118 | 106 | 94 | 84 | 75 | 163 | 163 | 163 | 159 | 151 | 142 | 134 | 117 | 102 | 89 | 78 | 68 | |
| 5 × 3½ | 5/16 | 5.12 | 17.4 | 1.61 | 1.45 | 77 | 77 | 77 | 77 | 77 | 74 | 70 | 64 | 57 | 51 | 46 | 41 | 37 | 77 | 77 | 77 | 77 | 74 | 71 | 67 | 60 | 53 | 47 | 41 | 37 | |
| | 3/8 | 6.10 | 20 8 | 1.60 | 1.46 | 92 | 92 | 92 | 92 | 92 | 88 | 84 | 76 | 68 | 61 | 55 | 49 | 44 | 92 | 92 | 92 | 92 | 89 | 84 | 80 | 71 | 63 | 56 | 50 | 44 | |
| | 7/16 | 7.06 | 24.0 | 1 59 | 1.47 | 106 | 106 | 106 | 106 | 106 | 101 | 97 | 87 | 78 | 70 | 63 | 56 | 50 | 106 | 106 | 106 | 106 | 103 | 98 | 93 | 83 | 74 | 65 | 58 | 51 | |
| | 1/2 | 8.00 | 27.2 | 1.58 | 1.49 | 120 | 120 | 120 | 120 | 120 | 114 | 109 | 99 | 88 | 79 | 71 | 63 | 56 | 120 | 120 | 120 | 120 | 117 | 112 | 106 | 95 | 84 | 75 | 66 | 59 | |
| | 9/16 | 8.94 | 30.4 | 1.57 | 1.50 | 134 | 134 | 134 | 134 | 133 | 127 | 121 | 110 | 98 | 88 | 78 | 70 | 62 | 134 | 134 | 134 | 134 | 131 | 125 | 119 | 107 | 95 | 84 | 75 | 66 | |
| | 5/8 | 9.84 | 33 6 | 1.56 | 1.51 | 148 | 148 | 148 | 148 | 146 | 140 | 133 | 120 | 108 | 96 | 86 | 76 | 68 | 148 | 148 | 148 | 148 | 145 | 138 | 131 | 118 | 105 | 93 | 83 | 74 | |
| | 11/16 | 10.74 | 36.6 | 1.56 | 1.52 | 161 | 161 | 161 | 161 | 160 | 153 | 146 | 131 | 118 | 105 | 94 | 83 | 75 | 161 | 161 | 161 | 161 | 158 | 151 | 144 | 129 | 115 | 103 | 91 | 81 | |
| | 3/4 | 11.62 | 39.6 | 1 55 | 1.54 | 174 | 174 | 174 | 174 | 172 | 165 | 157 | 141 | 127 | 113 | 101 | 90 | 80 | 174 | 174 | 174 | 174 | 172 | 164 | 156 | 141 | 126 | 112 | 100 | 89 | |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO UNEQUAL ANGLES

LONG LEGS BACK TO BACK

Loads to right of heavy vertical lines are for Secondary Members ONLY.

3/8" BACK TO BACK

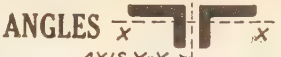
| Size | Thickness | Two Angles | | Radius of Gyration | | AXIS X - X Unsupported Length in Feet | | | | | | | | | | | AXIS Y - Y Unsupported Length in Feet | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | Weight | X-X | Y-Y | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| 6 × 3½ | 3/8 | 6.84 | 23.4 | 1.94 | 1.39 | 103 | 102 | 94 | 87 | 80 | 73 | 67 | 61 | 55 | 50 | 46 | ... | 103 | 102 | 97 | 92 | 87 | 77 | 68 | 60 | 53 | 46 | 41 | | | |
| | 7/16 | 7.94 | 27.0 | 1.93 | 1.40 | 119 | 118 | 109 | 101 | 92 | 84 | 77 | 70 | 64 | 58 | 53 | ... | 119 | 119 | 113 | 107 | 102 | 90 | 79 | 70 | 62 | 54 | 48 | | | |
| | 1/2 | 9.00 | 30.6 | 1.92 | 1.41 | 135 | 133 | 123 | 114 | 104 | 95 | 87 | 79 | 72 | 66 | 60 | ... | 135 | 135 | 129 | 122 | 116 | 103 | 91 | 80 | 70 | 62 | 55 | | | |
| | 9/16 | 10.06 | 34.2 | 1.91 | 1.42 | 151 | 148 | 138 | 127 | 116 | 106 | 96 | 88 | 80 | 73 | 67 | ... | 151 | 151 | 144 | 137 | 130 | 115 | 102 | 90 | 79 | 70 | 62 | | | |
| | 5/8 | 11.10 | 37.8 | 1.90 | 1.43 | 167 | 164 | 152 | 139 | 127 | 116 | 106 | 96 | 88 | 80 | 73 | ... | 167 | 167 | 160 | 152 | 144 | 128 | 113 | 100 | 88 | 78 | 69 | | | |
| | 11/16 | 12.12 | 41.2 | 1.89 | 1.45 | 182 | 178 | 165 | 152 | 139 | 126 | 115 | 105 | 95 | 87 | 79 | ... | 182 | 182 | 175 | 167 | 158 | 141 | 125 | 110 | 98 | 87 | 77 | | | |
| | 3/4 | 13.12 | 44.8 | 1.89 | 1.46 | 197 | 193 | 179 | 164 | 150 | 137 | 125 | 113 | 103 | 94 | 86 | ... | 197 | 197 | 190 | 181 | 172 | 153 | 136 | 120 | 107 | 94 | 84 | | | |
| | 13/16 | 14.12 | 48.0 | 1.88 | 1.48 | 212 | 207 | 192 | 176 | 161 | 147 | 133 | 121 | 110 | 101 | 92 | ... | 212 | 212 | 206 | 196 | 186 | 167 | 148 | 131 | 116 | 103 | 92 | | | |
| | 7/8 | 15.10 | 51.4 | 1.87 | 1.49 | 227 | 221 | 205 | 188 | 172 | 156 | 142 | 129 | 117 | 107 | 97 | ... | 227 | 227 | 221 | 211 | 200 | 179 | 159 | 141 | 125 | 111 | 99 | | | |
| 6 × 4 | 3/8 | 7.22 | 24.6 | 1.93 | 1.62 | 108 | 107 | 99 | 91 | 84 | 77 | 70 | 64 | 58 | 53 | 48 | ... | 108 | 108 | 108 | 104 | 100 | 90 | 81 | 73 | 65 | 59 | 53 | 47 | | |
| | 7/16 | 8.36 | 28.6 | 1.92 | 1.63 | 125 | 124 | 115 | 106 | 97 | 88 | 81 | 73 | 67 | 61 | 56 | ... | 125 | 125 | 125 | 121 | 116 | 105 | 95 | 85 | 76 | 68 | 61 | 55 | | |
| | 1/2 | 9.50 | 32.4 | 1.91 | 1.65 | 143 | 140 | 130 | 120 | 110 | 100 | 91 | 83 | 76 | 69 | 63 | ... | 143 | 143 | 143 | 138 | 132 | 120 | 109 | 98 | 88 | 79 | 71 | 64 | | |
| | 9/16 | 10.62 | 36.2 | 1.90 | 1.66 | 159 | 156 | 145 | 133 | 122 | 111 | 101 | 92 | 84 | 77 | 70 | ... | 159 | 159 | 159 | 155 | 148 | 135 | 122 | 110 | 98 | 88 | 80 | 72 | | |
| | 5/8 | 11.72 | 40.0 | 1.90 | 1.67 | 176 | 173 | 160 | 147 | 135 | 123 | 112 | 102 | 93 | 85 | 77 | ... | 176 | 176 | 176 | 171 | 164 | 149 | 135 | 122 | 109 | 98 | 88 | 80 | | |
| | 11/16 | 12.80 | 43.6 | 1.89 | 1.68 | 192 | 188 | 174 | 160 | 146 | 134 | 121 | 111 | 101 | 92 | 84 | ... | 192 | 192 | 192 | 187 | 180 | 164 | 148 | 134 | 120 | 108 | 97 | 87 | | |
| | 3/4 | 13.88 | 47.2 | 1.88 | 1.69 | 208 | 204 | 188 | 173 | 158 | 144 | 131 | 119 | 108 | 99 | 90 | ... | 208 | 208 | 208 | 204 | 195 | 178 | 161 | 146 | 131 | 118 | 106 | 96 | | |
| | 13/16 | 14.94 | 50.8 | 1.87 | 1.70 | 224 | 219 | 202 | 186 | 170 | 155 | 141 | 128 | 116 | 106 | 96 | ... | 224 | 224 | 224 | 220 | 211 | 192 | 174 | 158 | 142 | 128 | 115 | 104 | | |
| | 7/8 | 15.96 | 54.4 | 1.86 | 1.71 | 239 | 233 | 215 | 198 | 181 | 164 | 149 | 136 | 123 | 112 | 102 | ... | 239 | 239 | 239 | 235 | 226 | 206 | 187 | 169 | 152 | 137 | 124 | 112 | | |
| 7 × 3½ | 3/8 | 7.60 | 26.0 | 2.27 | 1.33 | 114 | 114 | 112 | 105 | 98 | 91 | 84 | 78 | 72 | 67 | 62 | 57 | 114 | 112 | 106 | 100 | 94 | 83 | 72 | 63 | 55 | 49 | 43 | | | |
| | 7/16 | 8.80 | 30.0 | 2.26 | 1.34 | 132 | 132 | 129 | 121 | 113 | 105 | 97 | 90 | 83 | 77 | 71 | 66 | 132 | 130 | 123 | 116 | 110 | 96 | 85 | 74 | 65 | 57 | 50 | | | |
| | 1/2 | 10.00 | 34.0 | 2.25 | 1.35 | 150 | 150 | 147 | 137 | 128 | 119 | 110 | 102 | 94 | 87 | 80 | 74 | 150 | 148 | 141 | 133 | 125 | 110 | 97 | 85 | 74 | 65 | 58 | | | |
| | 9/16 | 11.18 | 38.2 | 2.25 | 1.36 | 168 | 168 | 164 | 154 | 143 | 133 | 123 | 114 | 105 | 97 | 90 | 83 | 168 | 166 | 158 | 149 | 140 | 124 | 109 | 96 | 84 | 74 | 65 | | | |
| | 5/8 | 12.34 | 42.0 | 2.24 | 1.37 | 185 | 185 | 181 | 169 | 158 | 146 | 136 | 125 | 116 | 107 | 99 | 91 | 185 | 184 | 175 | 165 | 156 | 138 | 121 | 106 | 93 | 82 | 72 | | | |
| | 11/16 | 13.50 | 46 0 | 2.23 | 1.39 | 203 | 203 | 197 | 185 | 172 | 160 | 148 | 137 | 126 | 116 | 107 | 99 | 203 | 202 | 192 | 182 | 172 | 152 | 134 | 118 | 104 | 92 | 81 | | | |
| | 3/4 | 14.62 | 49.8 | 2.22 | 1.40 | 219 | 219 | 213 | 200 | 186 | 173 | 160 | 147 | 136 | 125 | 116 | 107 | 219 | 219 | 209 | 198 | 187 | 166 | 146 | 129 | 113 | 100 | 88 | | | |
| | 13/16 | 15.74 | 53.6 | 2.21 | 1.41 | 236 | 236 | 229 | 215 | 200 | 185 | 171 | 158 | 146 | 134 | 124 | 115 | 236 | 236 | 225 | 214 | 202 | 179 | 158 | 140 | 123 | 109 | 96 | | | |
| | 7/8 | 16.84 | 57.4 | 2.20 | 1.42 | 253 | 253 | 245 | 229 | 213 | 197 | 183 | 168 | 155 | 143 | 132 | 122 | 253 | 253 | 242 | 229 | 217 | 193 | 170 | 150 | 133 | 117 | 104 | | | |
| | 15/16 | 17.94 | 61.0 | 2.19 | 1.44 | 269 | 269 | 260 | 243 | 226 | 210 | 194 | 179 | 165 | 152 | 140 | 129 | 269 | 269 | 259 | 246 | 233 | 208 | 184 | 162 | 144 | 127 | 113 | | | |
| | 1" | 19.00 | 64.6 | 2.19 | 1 45 | 285 | 285 | 276 | 258 | 240 | 222 | 205 | 189 | 174 | 161 | 148 | 137 | 285 | 285 | 275 | 261 | 248 | 221 | 196 | 173 | 153 | 136 | 121 | | | |
| 8 × 6 | 7/16 | 11.86 | 40.4 | 2.57 | 2.43 | 178 | 178 | 178 | 173 | 163 | 153 | 144 | 135 | 126 | 117 | 110 | 102 | 178 | 178 | 178 | 178 | 178 | 178 | 169 | 158 | 148 | 138 | 129 | 120 | 111 | 104 |
| | 1/2 | 13.50 | 46.0 | 2.56 | 2.44 | 203 | 203 | 203 | 196 | 185 | 174 | 163 | 153 | 143 | 133 | 124 | 116 | 203 | 203 | 203 | 203 | 203 | 203 | 192 | 181 | 169 | 158 | 147 | 137 | 127 | 118 |
| | 9/16 | 15.12 | 51.4 | 2.55 | 2.46 | 227 | 227 | 227 | 219 | 208 | 195 | 182 | 171 | 159 | 148 | 138 | 129 | 227 | 227 | 227 | 227 | 227 | 227 | 216 | 203 | 191 | 178 | 166 | 155 | 144 | 134 |
| | 5/8 | 16.72 | 57.0 | 2.54 | 2.46 | 251 | 251 | 251 | 242 | 228 | 215 | 201 | 188 | 176 | 164 | 153 | 142 | 251 | 251 | 251 | 251 | 251 | 251 | 239 | 225 | 211 | 197 | 184 | 171 | 159 | 148 |
| | 11/16 | 18.30 | 62.4 | 2.54 | 2 47 | 275 | 275 | 275 | 265 | 250 | 235 | 220 | 206 | 192 | 179 | 167 | 156 | 275 | 275 | 275 | 275 | 275 | 275 | 262 | 247 | 231 | 216 | 202 | 188 | 175 | 162 |
| | 3/4 | 19.88 | 67.6 | 2.53 | 2.48 | 298 | 298 | 298 | 287 | 271 | 255 | 239 | 223 | 208 | 194 | 181 | 168 | 298 | 298 | 298 | 298 | 298 | 298 | 285 | 268 | 252 | 235 | 220 | 205 | 191 | 177 |
| | 13/16 | 21.44 | 73.0 | 2.52 | 2.49 | 322 | 322 | 322 | 309 | 292 | 274 | 257 | 240 | 224 | 208 | 194 | 181 | 322 | 322 | 322 | 322 | 322 | 322 | 308 | 290 | 272 | 255 | 238 | 222 | 206 | 192 |
| | 7/8 | 22.96 | 78.2 | 2.51 | 2.51 | 344 | 344 | 344 | 331 | 312 | 293 | 274 | 256 | 239 | 223 | 207 | 193 | 344 | 344 | 344 | 344 | 344 | 344 | 331 | 312 | 293 | 274 | 256 | 239 | 223 | 207 |
| | 15/16 | 24.50 | 83.4 | 2.50 | 2 51 | 368 | 368 | 368 | 353 | 332 | 311 | 292 | 272 | 254 | 236 | 220 | 205 | 368 | 368 | 368 | 368 | 368 | 368 | 353 | 333 | 312 | 293 | 273 | 255 | 237 | 221 |
| | 1" | 26.00 | 88.4 | 2.49 | 2.52 | 390 | 390 | 390 | 374 | 352 | 330 | 309 | 288 | 269 | 250 | 233 | 217 | 390 | 390 | 390 | 390 | 390 | 390 | 375 | 354 | 332 | 311 | 291 | 271 | 253 | 235 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO UNEQUAL ANGLES

SHORT LEGS BACK TO BACK

Loads to right of heavy vertical lines are for Secondary Members ONLY.




1/2" BACK TO BACK

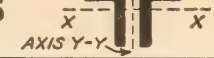
| Size | Thickness | Two Angles Area | Two Angles Weight | Radius of Gyration X-X | Radius of Gyration Y-Y | AXIS X - X Unsupported Length in Feet 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | AXIS Y - Y Unsupported Length in Feet 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 × 3½ | 3/8 | 6.84 | 23.4 | .99 | 3 00 | 103 | 102 | 95 | 88 | 81 | 74 | 68 | 57 | 47 | 40 | ... | ... | 103 | 100 | 96 | 91 | 86 | 81 | 77 | 73 | 68 | 64 | 61 | 57 | 54 | 51 |
| | 7/16 | 7 94 | 27 0 | .98 | 3 01 | 119 | 118 | 110 | 102 | 93 | 85 | 78 | 65 | 54 | 46 | ... | ... | 119 | 116 | 111 | 105 | 100 | 94 | 89 | 84 | 80 | 75 | 71 | 66 | 63 | 59 |
| | 1/2 | 9.00 | 30.6 | .97 | 3 02 | 135 | 133 | 124 | 114 | 105 | 98 | 87 | 73 | 61 | 51 | ... | ... | 135 | 132 | 126 | 120 | 114 | 108 | 102 | 96 | 91 | 85 | 80 | 76 | 71 | 67 |
| | 9/16 | 10.06 | 34.2 | .96 | 3.04 | 151 | 149 | 138 | 127 | 116 | 106 | 97 | 80 | 67 | 56 | ... | ... | 151 | 148 | 141 | 135 | 128 | 121 | 114 | 108 | 102 | 96 | 90 | 85 | 80 | 76 |
| | 5/8 | 11 10 | 37 8 | .96 | 3 05 | 167 | 164 | 152 | 140 | 128 | 117 | 107 | 89 | 74 | 62 | ... | ... | 167 | 164 | 156 | 149 | 141 | 134 | 126 | 119 | 113 | 106 | 100 | 94 | 89 | 84 |
| | 11/16 | 12 12 | 41.2 | .95 | 3 06 | 182 | 179 | 165 | 152 | 139 | 127 | 116 | 96 | 80 | ... | ... | ... | 182 | 179 | 171 | 163 | 154 | 146 | 138 | 131 | 123 | 116 | 110 | 104 | 98 | 92 |
| | 3/4 | 13.12 | 44.8 | .94 | 3 08 | 197 | 193 | 178 | 164 | 149 | 136 | 124 | 102 | 85 | ... | ... | ... | 197 | 194 | 186 | 177 | 168 | 159 | 150 | 142 | 134 | 127 | 120 | 113 | 107 | 100 |
| | 13/16 | 14 12 | 48 0 | .94 | 3 09 | 212 | 207 | 192 | 176 | 161 | 147 | 133 | 110 | 92 | ... | ... | ... | 212 | 209 | 200 | 190 | 181 | 171 | 162 | 153 | 145 | 137 | 129 | 122 | 115 | 109 |
| | 7/8 | 15 10 | 51 4 | .93 | 3 10 | 227 | 221 | 204 | 187 | 171 | 155 | 141 | 117 | 97 | ... | ... | ... | 227 | 224 | 214 | 204 | 194 | 184 | 174 | 164 | 155 | 147 | 138 | 131 | 123 | 117 |
| 6 × 4 | 3/8 | 7.22 | 24.6 | 1.17 | 2.92 | 108 | 108 | 107 | 101 | 95 | 88 | 82 | 71 | 60 | 52 | 45 | ... | 108 | 105 | 100 | 95 | 89 | 84 | 79 | 75 | 70 | 66 | 62 | 59 | 55 | 52 |
| | 7/16 | 8.36 | 28 6 | 1.16 | 2 93 | 125 | 125 | 124 | 117 | 109 | 102 | 95 | 81 | 69 | 59 | 50 | ... | 125 | 121 | 115 | 110 | 104 | 98 | 92 | 87 | 82 | 77 | 72 | 68 | 64 | 60 |
| | 1/2 | 9 50 | 32 4 | 1 15 | 2 95 | 142 | 142 | 140 | 132 | 124 | 115 | 107 | 92 | 78 | 67 | 58 | ... | 142 | 139 | 132 | 125 | 118 | 112 | 105 | 99 | 94 | 88 | 83 | 78 | 73 | 69 |
| | 9/16 | 10 62 | 36 2 | 1.14 | 2.96 | 159 | 159 | 157 | 147 | 137 | 127 | 119 | 102 | 87 | 74 | 64 | ... | 159 | 155 | 148 | 140 | 133 | 126 | 118 | 111 | 105 | 99 | 93 | 88 | 82 | 78 |
| | 5/8 | 11 72 | 40 0 | 1 13 | 2 97 | 176 | 176 | 172 | 162 | 150 | 139 | 130 | 111 | 94 | 81 | 70 | ... | 176 | 171 | 163 | 155 | 147 | 139 | 131 | 123 | 116 | 110 | 103 | 97 | 91 | 86 |
| | 11/16 | 12.80 | 43 6 | 1.13 | 2 98 | 192 | 192 | 188 | 176 | 164 | 153 | 142 | 121 | 103 | 88 | 76 | ... | 191 | 187 | 178 | 169 | 161 | 152 | 143 | 135 | 127 | 120 | 113 | 106 | 100 | 94 |
| | 3/4 | 13 88 | 47.2 | 1.12 | 2.99 | 208 | 208 | 203 | 190 | 177 | 165 | 153 | 130 | 111 | 95 | 81 | ... | 208 | 203 | 194 | 184 | 174 | 165 | 156 | 147 | 138 | 131 | 123 | 116 | 109 | 102 |
| | 13/16 | 14.94 | 50 8 | 1 11 | 3 00 | 224 | 224 | 218 | 204 | 190 | 176 | 163 | 139 | 118 | 101 | 87 | ... | 224 | 219 | 209 | 198 | 188 | 178 | 168 | 159 | 149 | 141 | 133 | 125 | 118 | 111 |
| | 7/8 | 15 96 | 54 4 | 1.11 | 3 02 | 239 | 239 | 233 | 218 | 203 | 188 | 174 | 148 | 126 | 108 | 93 | .. | 239 | 235 | 224 | 213 | 202 | 191 | 180 | 170 | 161 | 151 | 143 | 134 | 127 | 120 |
| 7 × 3½ | 3/8 | 7.60 | 26.0 | .96 | 3.55 | 114 | 112 | 104 | 96 | 88 | 80 | 73 | 61 | 51 | 42 | ... | ... | 114 | 114 | 113 | 109 | 105 | 100 | 96 | 90 | 87 | 83 | 79 | 75 | 71 | 68 |
| | 7/16 | 8.80 | 30.0 | .95 | 3 56 | 132 | 130 | 120 | 111 | 101 | 92 | 84 | 69 | 58 | ... | ... | ... | 132 | 132 | 131 | 127 | 121 | 116 | 111 | 106 | 101 | 96 | 92 | 87 | 83 | 79 |
| | 1/2 | 10.00 | 34.0 | .94 | 3 58 | 150 | 147 | 135 | 125 | 114 | 104 | 94 | 78 | 65 | ... | ... | ... | 150 | 150 | 150 | 144 | 138 | 133 | 127 | 121 | 115 | 110 | 105 | 99 | 95 | 90 |
| | 9/16 | 11.18 | 38.2 | .93 | 3.59 | 168 | 163 | 151 | 139 | 126 | 115 | 105 | 86 | 72 | ... | ... | ... | 168 | 168 | 168 | 161 | 155 | 148 | 142 | 135 | 129 | 124 | 117 | 112 | 106 | 101 |
| | 5/8 | 12.34 | 42.0 | .93 | 3.60 | 185 | 180 | 167 | 153 | 140 | 127 | 115 | 95 | 79 | ... | ... | ... | 185 | 185 | 185 | 178 | 171 | 164 | 157 | 150 | 143 | 136 | 130 | 123 | 117 | 112 |
| | 11/16 | 13.50 | 46.0 | .92 | 3 61 | 203 | 197 | 181 | 166 | 152 | 138 | 125 | 103 | 85 | ... | ... | ... | 203 | 203 | 203 | 195 | 187 | 180 | 172 | 164 | 156 | 149 | 142 | 135 | 129 | 123 |
| | 3/4 | 14 62 | 49 8 | .91 | 3 63 | 219 | 212 | 195 | 179 | 163 | 148 | 134 | 110 | 91 | ... | ... | ... | 219 | 219 | 219 | 212 | 203 | 195 | 187 | 178 | 170 | 162 | 155 | 147 | 140 | 133 |
| | 13/16 | 15.74 | 53.6 | .91 | 3.64 | 236 | 228 | 210 | 192 | 175 | 159 | 144 | 119 | 98 | ... | ... | ... | 236 | 236 | 236 | 228 | 219 | 210 | 201 | 192 | 184 | 175 | 167 | 159 | 151 | 144 |
| | 7/8 | 16.84 | 57.4 | .90 | 3.65 | 253 | 243 | 224 | 204 | 186 | 168 | 153 | 125 | 103 | ... | ... | ... | 253 | 253 | 253 | 244 | 235 | 225 | 216 | 206 | 197 | 188 | 179 | 170 | 162 | 155 |
| | 15/16 | 17.94 | 61.0 | .89 | 3 67 | 269 | 258 | 237 | 216 | 196 | 178 | 161 | 132 | 108 | ... | ... | ... | 269 | 269 | 269 | 261 | 251 | 241 | 230 | 220 | 210 | 201 | 191 | 182 | 174 | 166 |
| | 1" | 19 00 | 64 6 | .89 | 3.68 | 285 | 273 | 251 | 229 | 208 | 188 | 170 | 139 | 115 | ... | ... | ... | 285 | 285 | 285 | 277 | 266 | 255 | 244 | 234 | 223 | 213 | 203 | 194 | 185 | 176 |
| 8 × 6 | 7/16 | 11 86 | 40.4 | 1.80 | 3.73 | 178 | 178 | 178 | 178 | 178 | 178 | 171 | 158 | 144 | 130 | 119 | 108 | 178 | 178 | 178 | 174 | 167 | 161 | 154 | 147 | 141 | 134 | 128 | 122 | 117 | 111 |
| | 1/2 | 13 50 | 46 0 | 1.79 | 3.74 | 202 | 202 | 202 | 202 | 202 | 202 | 195 | 179 | 163 | 148 | 134 | 122 | 202 | 202 | 202 | 198 | 190 | 183 | 175 | 168 | 160 | 153 | 146 | 139 | 133 | 127 |
| | 9/16 | 15.12 | 51.4 | 1.78 | 3.75 | 227 | 227 | 227 | 227 | 227 | 226 | 217 | 200 | 182 | 165 | 150 | 135 | 227 | 227 | 227 | 222 | 213 | 205 | 197 | 188 | 180 | 172 | 164 | 157 | 149 | 142 |
| | 5/8 | 16.72 | 57.0 | 1.77 | 3 76 | 251 | 251 | 251 | 251 | 251 | 249 | 239 | 221 | 200 | 183 | 165 | 148 | 251 | 251 | 251 | 245 | 236 | 226 | 218 | 209 | 199 | 191 | 182 | 174 | 166 | 158 |
| | 11/16 | 18 30 | 62.4 | 1.77 | 3 77 | 275 | 275 | 275 | 275 | 275 | 273 | 262 | 241 | 219 | 199 | 180 | 163 | 275 | 275 | 275 | 269 | 259 | 249 | 239 | 229 | 219 | 209 | 199 | 191 | 182 | 173 |
| | 3/4 | 19 88 | 67.6 | 1.76 | 3.78 | 298 | 298 | 298 | 298 | 298 | 297 | 285 | 260 | 238 | 215 | 194 | 177 | 298 | 298 | 298 | 293 | 282 | 271 | 260 | 248 | 238 | 227 | 217 | 208 | 198 | 189 |
| | 13/16 | 21 44 | 73 0 | 1 75 | 3.79 | 322 | 322 | 322 | 322 | 322 | 319 | 306 | 280 | 255 | 231 | 209 | 189 | 322 | 322 | 322 | 316 | 304 | 292 | 280 | 269 | 257 | 246 | 235 | 224 | 214 | 204 |
| | 7/8 | 22 96 | 78.2 | 1.74 | 3.81 | 344 | 344 | 344 | 344 | 344 | 340 | 327 | 299 | 272 | 247 | 223 | 201 | 344 | 344 | 344 | 339 | 326 | 314 | 301 | 289 | 276 | 264 | 253 | 241 | 230 | 220 |
| | 15/16 | 24.50 | 83.4 | 1.73 | 3.81 | 368 | 368 | 368 | 368 | 368 | 363 | 348 | 319 | 289 | 262 | 236 | 213 | 368 | 368 | 368 | 361 | 348 | 335 | 321 | 308 | 295 | 282 | 270 | 257 | 245 | 234 |
| | 1" | 26.00 | 88.4 | 1.73 | 3.82 | 390 | 390 | 390 | 390 | 390 | 385 | 369 | 338 | 307 | 278 | 251 | 226 | 390 | 390 | 390 | 384 | 370 | 356 | 341 | 327 | 313 | 300 | 287 | 274 | 261 | 249 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR STRUTS OF TWO UNEQUAL ANGLES

LONG LEGS BACK TO BACK

Loads to right of heavy vertical lines are for Secondary Members ONLY.




1/2" BACK TO BACK

| Size | Thickness | Two Angles Area | Two Angles Weight | Radius of Gyration X-X | Radius of Gyration Y-Y | AXIS X-X Unsupported Length in Feet 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | AXIS Y-Y Unsupported Length in Feet 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 × 3½ | 3/8 | 6.84 | 23.4 | 1.94 | 1.43 | 103 | 102 | 94 | 87 | 80 | 73 | 67 | 61 | 55 | 50 | 46 | ... | 103 | 103 | 99 | 94 | 89 | 79 | 70 | 62 | 54 | 48 | 43 | | | |
| | 7/16 | 7.94 | 27.0 | 1.93 | 1.44 | 119 | 118 | 109 | 101 | 92 | 84 | 77 | 70 | 64 | 58 | 53 | ... | 119 | 119 | 115 | 109 | 103 | 92 | 81 | 72 | 64 | 56 | 50 | | | |
| | 1/2 | 9.00 | 30.6 | 1.92 | 1.46 | 135 | 133 | 123 | 114 | 104 | 95 | 87 | 79 | 72 | 66 | 60 | ... | 135 | 135 | 131 | 124 | 118 | 105 | 93 | 83 | 73 | 65 | 58 | | | |
| | 9/16 | 10.06 | 34.2 | 1.91 | 1.47 | 151 | 148 | 138 | 127 | 116 | 106 | 96 | 88 | 80 | 73 | 67 | ... | 151 | 151 | 146 | 139 | 132 | 118 | 105 | 93 | 82 | 73 | 65 | | | |
| | 5/8 | 11.10 | 37.8 | 1.90 | 1.48 | 167 | 164 | 152 | 139 | 127 | 116 | 106 | 96 | 88 | 80 | 73 | ... | 167 | 167 | 162 | 154 | 146 | 131 | 116 | 103 | 92 | 81 | 72 | | | |
| | 11/16 | 12.12 | 41.2 | 1.89 | 1.49 | 182 | 178 | 165 | 152 | 139 | 126 | 115 | 105 | 95 | 87 | 79 | ... | 182 | 182 | 177 | 169 | 160 | 144 | 128 | 113 | 101 | 89 | 80 | | | |
| | 3/4 | 13.12 | 44.8 | 1.89 | 1.51 | 197 | 193 | 179 | 164 | 150 | 137 | 125 | 113 | 103 | 94 | 86 | ... | 197 | 197 | 193 | 184 | 175 | 157 | 140 | 124 | 111 | 98 | 88 | | | |
| | 13/16 | 14.12 | 48.0 | 1.88 | 1.52 | 212 | 207 | 192 | 176 | 161 | 147 | 133 | 121 | 110 | 101 | 92 | ... | 212 | 212 | 208 | 199 | 189 | 170 | 151 | 135 | 120 | 107 | 95 | | | |
| | 7/8 | 15.10 | 51.4 | 1.87 | 1.53 | 227 | 221 | 205 | 188 | 172 | 156 | 142 | 129 | 117 | 107 | 97 | ... | 227 | 227 | 223 | 213 | 203 | 182 | 163 | 145 | 129 | 115 | 102 | | | |
| 6 × 4 | 3/8 | 7.22 | 24.6 | 1.93 | 1.67 | 108 | 107 | 99 | 91 | 84 | 77 | 70 | 64 | 58 | 53 | 48 | ... | 108 | 108 | 108 | 106 | 101 | 92 | 83 | 75 | 67 | 61 | 54 | 49 | | |
| | 7/16 | 8.36 | 28.6 | 1.92 | 1.68 | 125 | 124 | 115 | 106 | 97 | 88 | 81 | 73 | 67 | 61 | 56 | ... | 125 | 125 | 125 | 122 | 117 | 107 | 97 | 87 | 78 | 71 | 64 | 57 | | |
| | 1/2 | 9.50 | 32.4 | 1.91 | 1.69 | 143 | 140 | 130 | 120 | 110 | 100 | 91 | 83 | 76 | 69 | 63 | ... | 143 | 143 | 143 | 139 | 134 | 122 | 110 | 100 | 90 | 81 | 73 | 65 | | |
| | 9/16 | 10.62 | 36.2 | 1.90 | 1.70 | 159 | 156 | 145 | 133 | 122 | 111 | 101 | 92 | 84 | 77 | 70 | ... | 159 | 159 | 159 | 156 | 150 | 137 | 124 | 112 | 101 | 91 | 82 | 74 | | |
| | 5/8 | 11.72 | 40.0 | 1.90 | 1.71 | 176 | 173 | 160 | 147 | 135 | 123 | 112 | 102 | 93 | 85 | 77 | ... | 176 | 176 | 176 | 173 | 166 | 151 | 137 | 124 | 112 | 101 | 91 | 82 | | |
| | 11/16 | 12.80 | 43.6 | 1.89 | 1.73 | 192 | 188 | 174 | 160 | 146 | 134 | 121 | 111 | 101 | 92 | 84 | ... | 192 | 192 | 192 | 189 | 182 | 166 | 151 | 137 | 124 | 111 | 101 | 91 | | |
| | 3/4 | 13.88 | 47.2 | 1.88 | 1.74 | 208 | 204 | 188 | 173 | 158 | 144 | 131 | 119 | 108 | 99 | 90 | ... | 208 | 208 | 208 | 206 | 198 | 181 | 165 | 149 | 135 | 122 | 110 | 99 | 90 | |
| | 13/16 | 14.94 | 50.8 | 1.87 | 1.75 | 224 | 219 | 202 | 186 | 170 | 155 | 141 | 128 | 116 | 106 | 96 | ... | 224 | 224 | 224 | 222 | 213 | 195 | 178 | 161 | 146 | 132 | 119 | 107 | 97 | |
| | 7/8 | 15 96 | 54.4 | 1 86 | 1.76 | 239 | 233 | 215 | 198 | 181 | 164 | 149 | 136 | 123 | 112 | 102 | ... | 239 | 239 | 239 | 238 | 228 | 209 | 191 | 173 | 156 | 141 | 128 | 116 | 105 | |
| 7 × 3½ | 3/8 | 7.60 | 26.0 | 2.27 | 1.37 | 114 | 114 | 112 | 105 | 98 | 91 | 84 | 78 | 72 | 67 | 62 | 57 | 114 | 113 | 108 | 102 | 96 | 85 | 75 | 65 | 58 | 51 | 45 | | | |
| | 7/16 | 8.80 | 30.0 | 2.26 | 1.38 | 132 | 132 | 129 | 121 | 113 | 105 | 97 | 90 | 83 | 77 | 71 | 66 | 132 | 131 | 125 | 118 | 112 | 99 | 87 | 76 | 67 | 59 | 52 | | | |
| | 1/2 | 10.00 | 34.0 | 2.25 | 1.39 | 150 | 150 | 147 | 137 | 128 | 119 | 110 | 102 | 94 | 87 | 80 | 74 | 150 | 150 | 142 | 135 | 127 | 113 | 99 | 87 | 77 | 68 | 60 | | | |
| | 9/16 | 11.18 | 38.2 | 2.25 | 1.41 | 168 | 168 | 164 | 154 | 143 | 133 | 123 | 114 | 105 | 97 | 90 | 83 | 168 | 168 | 160 | 152 | 144 | 128 | 113 | 99 | 87 | 77 | 68 | | | |
| | 5/8 | 12.34 | 42.0 | 2.24 | 1.42 | 185 | 185 | 181 | 169 | 158 | 146 | 136 | 125 | 116 | 107 | 99 | 91 | 185 | 185 | 177 | 168 | 159 | 141 | 125 | 110 | 97 | 86 | 76 | | | |
| | 11/16 | 13.50 | 46.0 | 2.23 | 1.43 | 203 | 203 | 197 | 185 | 172 | 160 | 148 | 137 | 126 | 116 | 107 | 99 | 203 | 203 | 194 | 185 | 175 | 155 | 138 | 121 | 107 | 95 | 84 | | | |
| | 3/4 | 14.62 | 49.8 | 2.22 | 1.45 | 219 | 219 | 213 | 200 | 186 | 173 | 160 | 147 | 136 | 125 | 116 | 107 | 219 | 219 | 212 | 201 | 191 | 170 | 151 | 133 | 118 | 104 | 93 | | | |
| | 13/16 | 15.74 | 53.6 | 2.21 | 1.46 | 236 | 236 | 229 | 215 | 200 | 185 | 171 | 158 | 146 | 134 | 124 | 115 | 236 | 236 | 228 | 217 | 206 | 184 | 163 | 144 | 128 | 113 | 101 | | | |
| | 7/8 | 16 84 | 57.4 | 2.20 | 1.47 | 253 | 253 | 245 | 229 | 213 | 197 | 183 | 168 | 155 | 143 | 132 | 122 | 253 | 253 | 245 | 233 | 221 | 198 | 176 | 156 | 138 | 122 | 109 | | | |
| | 15/16 | 17.94 | 61.0 | 2.19 | 1.49 | 269 | 269 | 260 | 243 | 226 | 210 | 194 | 179 | 165 | 152 | 140 | 129 | 269 | 269 | 262 | 250 | 237 | 213 | 189 | 168 | 149 | 132 | 118 | | | |
| | 1" | 19 00 | 64.6 | 2 19 | 1 50 | 285 | 285 | 276 | 258 | 240 | 222 | 205 | 189 | 174 | 161 | 148 | 137 | 285 | 285 | 279 | 266 | 252 | 226 | 202 | 179 | 159 | 141 | 126 | | | |
| 8 × 6 | 7/16 | 11.86 | 40 4 | 2.57 | 2.48 | 178 | 178 | 178 | 173 | 163 | 153 | 144 | 135 | 126 | 117 | 110 | 102 | 178 | 178 | 178 | 178 | 178 | 178 | 170 | 160 | 150 | 140 | 131 | 122 | 114 | 106 |
| | 1/2 | 13.50 | 46.0 | 2.56 | 2.48 | 203 | 203 | 203 | 196 | 185 | 174 | 163 | 153 | 143 | 133 | 124 | 116 | 203 | 203 | 203 | 203 | 203 | 203 | 194 | 182 | 171 | 160 | 149 | 139 | 129 | 120 |
| | 9/16 | 15.12 | 51.4 | 2.55 | 2.50 | 227 | 227 | 227 | 219 | 208 | 195 | 182 | 171 | 159 | 148 | 138 | 129 | 227 | 227 | 227 | 227 | 227 | 227 | 218 | 205 | 192 | 180 | 168 | 157 | 146 | 136 |
| | 5/8 | 16.72 | 57.0 | 2.54 | 2 51 | 251 | 251 | 251 | 242 | 228 | 215 | 201 | 188 | 176 | 164 | 153 | 142 | 251 | 251 | 251 | 251 | 251 | 251 | 241 | 227 | 213 | 200 | 186 | 174 | 162 | 151 |
| | 11/16 | 18.30 | 62.4 | 2 54 | 2.52 | 275 | 275 | 275 | 265 | 250 | 235 | 220 | 206 | 192 | 179 | 167 | 156 | 275 | 275 | 275 | 275 | 275 | 275 | 264 | 249 | 234 | 219 | 205 | 191 | 178 | 166 |
| | 3/4 | 19 88 | 67.6 | 2.53 | 2 52 | 298 | 298 | 298 | 287 | 271 | 255 | 239 | 223 | 208 | 194 | 181 | 168 | 298 | 298 | 298 | 298 | 298 | 298 | 287 | 271 | 254 | 238 | 222 | 207 | 193 | 180 |
| | 13/16 | 21.44 | 73.0 | 2.52 | 2 54 | 322 | 322 | 322 | 309 | 292 | 274 | 257 | 240 | 224 | 208 | 194 | 181 | 322 | 322 | 322 | 322 | 322 | 322 | 310 | 293 | 275 | 258 | 241 | 225 | 210 | 196 |
| | 7/8 | 22.96 | 78.2 | 2 51 | 2 55 | 344 | 344 | 344 | 331 | 312 | 293 | 274 | 256 | 239 | 223 | 207 | 193 | 344 | 344 | 344 | 344 | 344 | 344 | 333 | 316 | 295 | 277 | 259 | 242 | 225 | 210 |
| | 15/16 | 24.50 | 83.4 | 2.50 | 2.56 | 368 | 368 | 368 | 353 | 332 | 311 | 292 | 272 | 254 | 236 | 220 | 205 | 368 | 368 | 368 | 368 | 368 | 368 | 356 | 336 | 316 | 296 | 277 | 259 | 242 | 225 |
| | 1" | 26.00 | 88.4 | 2.49 | 2 57 | 390 | 390 | 390 | 374 | 352 | 330 | 309 | 288 | 269 | 250 | 233 | 217 | 390 | 390 | 390 | 390 | 390 | 390 | 378 | 357 | 336 | 315 | 295 | 276 | 257 | 240 |

LOADS BY A. I. S. C. SPECIFICATION

# ALLOWABLE UNIFORM LOAD IN KIPS FOR STANDARD ANGLES USED AS BEAMS

| Position | Angle Size | Angle Thickness | Weight per foot | Coef of Strength | Length in Span in feet. Laterally supported. 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equal Legs | 2½ × 2½ | ¼ | 4 1 | 4719 | 1 57 | 1.18 | .94 | .79 | .67 | .59 | .52 | .47 | .43 | | | |
| | | 5/16 | 5 0 | 5795 | 1 93 | 1 45 | 1 16 | .97 | .83 | .72 | .64 | .58 | .53 | | | |
| | 3 × 3 | ¼ | 4 9 | 6889 | 2 30 | 1 72 | 1.38 | 1 15 | .98 | .86 | .77 | .69 | .63 | .57 | | |
| | | 5/16 | 6.1 | 8507 | 2 84 | 2 13 | 1 70 | 1.42 | 1.22 | 1 06 | .95 | .85 | .77 | .71 | | |
| | 3½ × 3½ | 5/16 | 7 2 | 11713 | 3 90 | 2 93 | 2 34 | 1.95 | 1.67 | 1.46 | 1.30 | 1.17 | 1.06 | .98 | | |
| | | 3/8 | 8 5 | 13831 | 4.61 | 3.46 | 2 77 | 2.31 | 1 98 | 1.73 | 1.54 | 1.38 | 1.26 | 1.15 | | |
| | 4 × 4 | 5/16 | 8 2 | 15458 | 5 15 | 3 86 | 3.09 | 2 58 | 2.21 | 1.93 | 1.72 | 1.55 | 1.41 | 1.29 | 1.19 | |
| | | 3/8 | 9.8 | 18294 | 6.10 | 4 57 | 3.66 | 3 05 | 2.61 | 2.29 | 2.03 | 1.83 | 1.66 | 1.52 | 1.41 | |
| | 6 × 6 | 3/8 | 14 9 | 42358 | 14 12 | 10 59 | 8 47 | 7.06 | 6 05 | 5.29 | 4.71 | 4.24 | 3 85 | 3.53 | 3.26 | 3.03 |
| | | ½ | 19 6 | 55305 | 18 44 | 13 83 | 11 06 | 9.22 | 7 90 | 6.91 | 6 15 | 5.53 | 5.03 | 4.62 | 4.25 | 3.95 |
| Long Leg Up | 3 × 2½ | ¼ | 4 5 | 6718 | 2 24 | 1 68 | 1 34 | 1.12 | .96 | .84 | .75 | .67 | .61 | | | |
| | | 5/16 | 5 6 | 8231 | 2 74 | 2 06 | 1 65 | 1.37 | 1.18 | 1.03 | .91 | .82 | .75 | | | |
| | 3½ × 2½ | ¼ | 4 9 | 9038 | 3 01 | 2 26 | 1.81 | 1 51 | 1.29 | 1.13 | 1.00 | .90 | .82 | .75 | | |
| | | 5/16 | 6 1 | 11136 | 3 71 | 2 78 | 2 23 | 1.86 | 1 59 | 1.39 | 1.24 | 1.11 | 1 01 | .93 | | |
| | 4 × 3 | 5/16 | 7.2 | 14802 | 4 93 | 3 70 | 2 96 | 2 47 | 2.11 | 1.85 | 1.64 | 1.48 | 1.35 | 1.23 | 1.14 | |
| | | 3/8 | 8.5 | 17471 | 5 82 | 4 37 | 3 49 | 2.91 | 2 50 | 2.18 | 1.94 | 1.75 | 1.59 | 1.46 | 1.34 | |
| | 4 × 3½ | 5/16 | 7 7 | 15149 | 5 05 | 3 79 | 3 03 | 2 52 | 2.16 | 1.89 | 1.68 | 1.51 | 1.38 | 1 26 | 1.17 | |
| | | 3/8 | 9.1 | 17978 | 5 99 | 4 49 | 3.60 | 3 00 | 2.57 | 2.25 | 2 00 | 1.80 | 1.63 | 1.50 | 1.38 | |
| | 5 × 3 | 5/16 | 8.2 | 22626 | 7 54 | 5 66 | 4 53 | 3.77 | 3 23 | 2 83 | 2.51 | 2.26 | 2.06 | 1.89 | 1.74 | 1.62 |
| | | 3/8 | 9.8 | 26800 | 8.93 | 6 70 | 5.36 | 4.47 | 3.83 | 3.35 | 2.98 | 2.68 | 2 44 | 2.23 | 2.06 | 1.91 |
| | 5 × 3½ | 5/16 | 8 7 | 23226 | 7 74 | 5 81 | 4.65 | 3 87 | 3.32 | 2.90 | 2.58 | 2.32 | 2.11 | 1.94 | 1.79 | 1.66 |
| | | 3/8 | 10 4 | 27540 | 9.18 | 6 89 | 5.51 | 4.59 | 3.93 | 3.44 | 3.06 | 2.75 | 2.50 | 2.30 | 2.12 | 1.97 |
| | 6 × 4 | 3/8 | 12 3 | 39813 | 13 27 | 9 95 | 7.96 | 6 64 | 5 69 | 4.98 | 4.42 | 3.98 | 3.62 | 3.32 | 3.06 | 2.84 |
| | | ½ | 16 2 | 52070 | 17.36 | 13 02 | 10 41 | 8 68 | 7 44 | 6 51 | 5.79 | 5.21 | 4.73 | 4.34 | 4 01 | 3.72 |
| Short Leg Up | 3 × 2½ | ¼ | 4 5 | 4826 | 1 61 | 1 21 | 96 | .80 | .69 | .60 | .54 | .48 | .44 | | | |
| | | 5/16 | 5 6 | 5934 | 1 98 | 1 48 | 1.19 | .99 | .85 | .74 | .66 | .59 | .54 | | | |
| | 3½ × 2½ | ¼ | 4 9 | 4952 | 1 65 | 1 24 | .99 | .83 | .71 | .62 | .55 | .50 | .45 | .41 | | |
| | | 5/16 | 6 1 | 6064 | 2.02 | 1 52 | 1.21 | 1 01 | .87 | .76 | .67 | .61 | .55 | .51 | | |
| | 4 × 3 | 5/16 | 7 2 | 8839 | 2.95 | 2 21 | 1.77 | 1 47 | 1.26 | 1.10 | .98 | .88 | .80 | .74 | .68 | |
| | | 3/8 | 8 5 | 10378 | 3.46 | 2 59 | 2.08 | 1.73 | 1.48 | 1.30 | 1.15 | 1 04 | .94 | .86 | .80 | |
| | 4 × 3½ | 5/16 | 7 7 | 11907 | 3 97 | 2 98 | 2.38 | 1.98 | 1 70 | 1.49 | 1.32 | 1.19 | 1.08 | .99 | .92 | |
| | | 3/8 | 9.1 | 14126 | 4 71 | 3 53 | 2.83 | 2.35 | 2.02 | 1.77 | 1.57 | 1.41 | 1.28 | 1.18 | 1.09 | |
| | 5 × 3 | 5/16 | 8 2 | 9052 | 3.02 | 2 26 | 1.81 | 1.51 | 1.29 | 1.13 | 1.01 | .91 | .82 | .75 | .70 | |
| | | 3/8 | 9.8 | 10643 | 3.55 | 2.66 | 2.13 | 1.77 | 1.52 | 1.33 | 1.18 | 1.06 | .97 | .89 | .82 | |
| | 5 × 3½ | 5/16 | 8 7 | 12271 | 4 09 | 3 07 | 2.45 | 2.05 | 1.75 | 1.53 | 1.36 | 1 23 | 1.12 | 1.02 | .94 | |
| | | 3/8 | 10 4 | 14454 | 4.82 | 3 61 | 2.89 | 2.41 | 2.06 | 1.81 | 1.61 | 1 45 | 1.31 | 1.20 | 1.11 | |
| | 6 × 4 | 3/8 | 12 3 | 19216 | 6.41 | 4.80 | 3 84 | 3.20 | 2.75 | 2.40 | 2.14 | 1.92 | 1.75 | 1.60 | 1.48 | 1.37 |
| | | ½ | 16.2 | 24997 | 8.33 | 6 25 | 5.00 | 4.17 | 3.57 | 3.12 | 2.78 | 2.50 | 2.27 | 2.08 | 1.92 | 1.79 |

For Loads for Spans not tabulated divide the Coefficient of Strength by the Span in feet.

# Part IV
# Section 3

## American Standard Channels

**Dimensions**

**Technical Functions**

**Allowable Total Loads**

**by**

**A. I. S. C. Specification**

**Connection Angles**

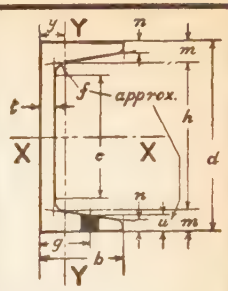
| Usual Stock Sizes | |
|---|---|
| Depth | Weight |
| 3″ | 4.1# |
| 4 | 5.4 |
| 5 | 6.7 |
| 6 | 8.2 |
| 7 | 9.8 |
| 8 | 11.5 |
| 9 | 13.4 |
| 10 | 15.3 |
| 12 | 20.7 |
| 15 | 33.9 |

# 3" [ STANDARD CHANNELS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



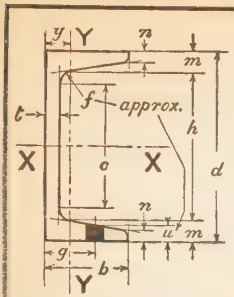

| Depth = d" | | | 3 | 3 | 3 |
|---|---|---|---|---|---|
| Wt. per foot | | | 4.1 | 5.0 | 6.0 |
| Area, sq. in. | | | 1.19 | 1.46 | 1.75 |
| b" | | | 1.41 | 1.50 | 1.60 |
| t | | | .170 | .258 | .356 |
| h | | | 2.246 | 2.246 | 2.246 |
| m | | | .377 | .377 | .377 |
| n | | | .170 | .170 | .170 |
| f | | | .270 | .270 | .270 |
| c | | | 1.789 | 1.789 | 1.789 |
| g | | | 7/8 | 7/8 | 7/8 |
| u | | | 1/4 | 1/4 | 1/4 |
| AXES | X-X | I | 1.6 | 1.8 | 2.1 |
| | | S | 1.07 | 1.2 | 1.4 |
| | | r | 1.17 | 1.12 | 1.08 |
| | Y-Y | I | 0.20 | 0.25 | 0.31 |
| | | S | 0.21 | 0.24 | 0.27 |
| | | r | 0.41 | 0.41 | 0.42 |
| | | v | 0.44 | 0.44 | 0.46 |
| Coef. Str. | | | 12800 | 14400 | 16800 |
| Max. Mom." # | | | 19200 | 21600 | 25200 |
| V | | | 6100 | 9300 | 12800 |
| P, feet | | | 1.05 | .77 | .66 |
| W | | | 7700 | 11600 | 11900 |
| Q feet | | | .83 | .62 | .71 |
| w, lbs. | | | 5 | 5 | 5 |
| Rivet dia. | | | 1/2 | 1/2 | 1/2 |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 1 | 12.2 | 12.2 | 11.4 | 14.4 | 16.8 | 16.8 | |
| 2 | 6.4 | 6.3 | 7.2 | 7.1 | 8.4 | 8.4 | .025 |
| 3 | 4.3 | 3.7 | 4.8 | 4.1 | 5.6 | 5.0 | .056 |
| 4 | 3.2 | 2.3 | 3.6 | 2.6 | 4.2 | 3.2 | .099 |
| 5 | 2.6 | .. | 2.9 | 1.8 | 3.4 | 2.2 | .155 |
| 6 | 2.1 | .. | 2.4 | .. | 2.8 | .. | .223 |
| 7 | 1.8 | .. | 2.1 | .. | 2.4 | .. | .304 |
| 8 | 1.6 | .. | 1.8 | .. | 2.1 | .. | .396 |
| 9 | 1.4 | .. | 1.6 | .. | 1.9 | .. | .503 |
| 10 | 1.3 | .. | 1.4 | .. | 1.7 | .. | .620 |
| 11 | 1.2 | .. | 1.3 | .. | 1.5 | .. | .750 |
| 12 | 1.1 | .. | 1.2 | .. | 1.4 | .. | .896 |
| 13 | 1.0 | .. | 1.1 | .. | 1.3 | .. | 1.05 |
| 14 | 0.9 | .. | 1.0 | .. | 1.2 | .. | 1.22 |
| 15 | 0.8 | .. | 1.0 | .. | 1.1 | .. | 1.39 |




# STANDARD CHANNELS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

4"

| Depth = d" | | | 4 | 4 | 4 |
|---|---|---|---|---|---|
| Wt. per foot | | | 5.4 | 6.25 | 7.25 |
| Area, sq. in. | | | 1.56 | 1.82 | 2.12 |
| b" | | | 1.58 | 1.65 | 1.72 |
| t | | | .180 | .247 | .320 |
| h | | | 3.174 | 3.174 | 3.174 |
| m | | | .413 | .413 | .413 |
| n | | | .180 | .180 | .180 |
| f | | | .280 | .280 | .280 |
| c | | | 2.700 | 2.700 | 2.700 |
| g | | | 1" | 1" | 1" |
| u | | | 5/16 | 5/16 | 5/16 |
| AXES | X-X | I | 3.8 | 4.1 | 4.5 |
| | | S | 1.9 | 2.05 | 2.25 |
| | | r | 1.56 | 1.50 | 1.47 |
| | Y-Y | I | 0.32 | 0.38 | 0.44 |
| | | S | 0.29 | 0.32 | 0.35 |
| | | r | 0.45 | 0.45 | 0.46 |
| | | y | 0.46 | 0.46 | 0.46 |
| Coef. Str. | | | 22800 | 24600 | 27000 |
| Max. Mom." $ | | | 34200 | 36900 | 40500 |
| V | | | 3600 | 11900 | 15400 |
| P. feet | | | 1.33 | 1.03 | 0.88 |
| W | | | 8100 | 11100 | 11900 |
| Q. feet | | | 1.41 | 1.11 | 1.13 |
| w. lbs. | | | 5 | 5 | 5 |
| Rivet dia. | | | ½ | ½ | ½ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 1 | 17.2 | 17.2 | 23.8 | 23.8 | 27.0 | 27.0 | |
| 2 | 11.4 | 11.4 | 12.3 | 12.3 | 13.5 | 13.5 | .019 |
| 3 | 7.6 | 6.7 | 8.2 | 7.3 | 9.0 | 8.3 | .042 |
| 4 | 5.7 | 4.3 | 6.2 | 4.8 | 6.7 | 5.4 | .074 |
| 5 | 4.6 | 3.0 | 4.9 | 3.4 | 5.4 | 3.7 | .116 |
| 6 | 3.8 | .. | 4.1 | .. | 4.5 | .. | .168 |
| 7 | 3.3 | .. | 3.5 | .. | 3.8 | .. | .228 |
| 8 | 2.9 | .. | 3.1 | .. | 3.4 | .. | .298 |
| 9 | 2.5 | .. | 2.7 | .. | 3.0 | .. | .378 |
| 10 | 2.3 | .. | 2.5 | .. | 2.7 | .. | .465 |
| 11 | 2.1 | .. | 2.2 | .. | 2.5 | .. | .562 |
| 12 | 1.9 | .. | 2.1 | .. | 2.3 | .. | .670 |
| 13 | 1.8 | .. | 1.9 | .. | 2.1 | .. | .787 |
| 14 | 1.6 | .. | 1.8 | .. | 1.9 | .. | .912 |
| 15 | 1.5 | .. | 1.6 | .. | 1.8 | .. | 1.05 |

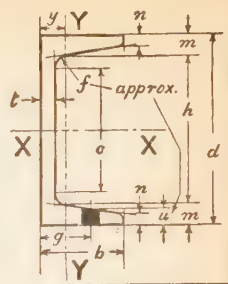
# 5" [

## STANDARD CHANNELS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



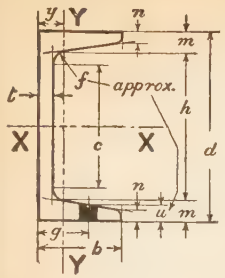

| | | | | |
|---|---|---|---|---|
| Depth = d" | | 5 | 5 | 5 |
| Wt. per foot | | 6.7 | 9.0 | 11.5 |
| Area, sq. in. | | 1.95 | 2.63 | 3.36 |
| b" | | 1.75 | 1.89 | 2.03 |
| t | | .190 | .325 | .472 |
| h | | 4.100 | 4.100 | 4.100 |
| m | | .450 | .450 | .450 |
| n | | .190 | .190 | .190 |
| f | | .290 | .290 | .290 |
| c | | 3.609 | 3.609 | 3.609 |
| g | | 1⅛ | 1⅛ | 1⅛ |
| u | | 5/16 | 5/16 | 5/16 |
| AXES X-X | I | 7.4 | 8.8 | 10.4 |
| | S | 2.96 | 3.52 | 4.16 |
| | r | 1.95 | 1.83 | 1.76 |
| AXES Y-Y | I | 0.48 | 0.64 | 0.82 |
| | S | 0.38 | 0.45 | 0.54 |
| | r | 0.50 | 0.49 | 0.49 |
| | y | 0.49 | 0.48 | 0.51 |
| Coef. Str. | | 35500 | 42200 | 49900 |
| Max. Mom." # | | 53300 | 63400 | 74900 |
| V | | 11400 | 19500 | 28500 |
| P. feet | | 1.56 | 1.08 | 0.88 |
| W | | 8600 | 11900 | 11900 |
| Q. feet | | 2.07 | 1.77 | 2.10 |
| w. lbs. | | 6 | 6 | 6 |
| Rivet dia. | | ½ | ½ | ½ |

Live Load Deflection must not exceed 1-360 of the Span.

Live Load Def. = (Total Def. × Live Load) / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 1 | 22.8 | 22.8 | 39.0 | 39.0 | 49.2 | 49.2 | |
| 2 | 17.8 | 17.8 | 21.1 | 21.1 | 24.9 | 24.9 | |
| 3 | 11.8 | 10.9 | 14.0 | 13.2 | 16.6 | 15.6 | .033 |
| 4 | 8.9 | 7.2 | 10.5 | 8.8 | 12.5 | 10.4 | .059 |
| 5 | 7.1 | 5.0 | 8.4 | 6.2 | 10.0 | 7.4 | .093 |
| 6 | 5.9 | .. | 7.0 | 4.5 | 8.3 | 5.3 | .134 |
| 7 | 5.1 | .. | 6.0 | .. | 7.1 | .. | .182 |
| 8 | 4.4 | .. | 5.3 | .. | 6.2 | .. | .238 |
| 9 | 3.9 | .. | 4.7 | .. | 5.5 | .. | .302 |
| 10 | 3.6 | .. | 4.2 | .. | 5.0 | .. | .372 |
| 11 | 3.2 | .. | 3.8 | .. | 4.5 | .. | .450 |
| 12 | 3.0 | .. | 3.5 | .. | 4.2 | .. | .537 |
| 13 | 2.7 | .. | 3.2 | .. | 3.8 | .. | .630 |
| 14 | 2.5 | .. | 3.0 | .. | 3.6 | .. | .730 |
| 15 | 2.4 | .. | 2.8 | .. | 3.3 | .. | .838 |
| 16 | 2.2 | .. | 2.6 | .. | 3.1 | .. | .955 |
| 17 | 2.1 | .. | 2.5 | .. | 2.9 | .. | 1.08 |
| 18 | 2.0 | .. | 2.3 | .. | 2.8 | .. | 1.20 |
| 19 | 1.9 | .. | 2.2 | .. | 2.6 | .. | 1.34 |
| 20 | 1.8 | .. | 2.1 | .. | 2.5 | .. | 1.49 |




# STANDARD CHANNELS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

**6"**

| Depth = d" | | 6 | 6 | 6 | 6 |
|---|---|---|---|---|---|
| Wt. per foot | | 8.2 | 10.5 | 13.0 | 15.5 |
| Area, sq. in. | | 2.39 | 3.07 | 3.81 | 4.54 |
| b" | | 1.92 | 2.03 | 2.16 | 2.28 |
| t | | .200 | .314 | .437 | .559 |
| h | | 5.026 | 5.026 | 5.026 | 5.026 |
| m | | .487 | .487 | .487 | .487 |
| n | | .200 | .200 | .200 | .200 |
| f | | .300 | .300 | .300 | .300 |
| c | | 4.518 | 4.518 | 4.518 | 4.518 |
| g | | 1⅛ | 1⅛ | 1⅜ | 1⅜ |
| u | | 5/16 | ⅜ | ¾ | ⅜ |
| AXES X-X | I | 13.0 | 15.1 | 17.3 | 19.5 |
| | S | 4.33 | 5.03 | 5.77 | 6.5 |
| | r | 2.34 | 2.22 | 2.13 | 2.07 |
| AXES Y-Y | I | 0.70 | 0.87 | 1.1 | 1.3 |
| | S | 0.50 | 0.57 | 0.65 | 0.73 |
| | r | 0.54 | 0.53 | 0.53 | 0.53 |
| | v | 0.52 | 0.50 | 0.52 | 0.55 |
| Coef. Str. | | 52000 | 60400 | 69200 | 78000 |
| Max. Mom." S | | 78000 | 90200 | 103800 | 117000 |
| V | | 14400 | 22600 | 31500 | 40200 |
| P, feet | | 1.81 | 1.34 | 1.10 | .97 |
| W | | 9000 | 11900 | 11900 | 11900 |
| Q, feet | | 2.89 | 2.54 | 2.91 | 3.28 |
| w, lbs. | | 6 | 6 | 6 | 6 |
| Rivet dia. | | ⅝ | ⅝ | ⅝ | ⅝ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{LiveLoad Def.} = \frac{\text{Total Def.} \times \text{LiveLoad}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 28.8 | 28.8 | 45.2 | 45.2 | 63.0 | 63.0 | 78.0 | 78.0 | |
| 2 | 26.0 | 26.0 | 30.2 | 30.2 | 34.6 | 34.6 | 39.0 | 39.0 | |
| 3 | 17.3 | 16.4 | 20.1 | 19.3 | 23.1 | 22.5 | 26.0 | 25.7 | .028 |
| 4 | 13.0 | 11.0 | 15.1 | 13.1 | 17.3 | 15.4 | 19.5 | 18.1 | .050 |
| 5 | 10.4 | 7.8 | 12.1 | 9.4 | 13.8 | 11.0 | 15.6 | 12.9 | .078 |
| 6 | 8.7 | 5.7 | 10.1 | 6.9 | 11.5 | 8.3 | 13.0 | 9.6 | .112 |
| 7 | 7.4 | .. | 8.6 | .. | 9.9 | .. | 11.1 | 7.3 | .152 |
| 8 | 6.5 | .. | 7.6 | .. | 8.7 | .. | 9.8 | .. | .198 |
| 9 | 5.8 | .. | 6.7 | .. | 7.7 | .. | 8.7 | .. | .252 |
| 10 | 5.2 | .. | 6.0 | .. | 6.9 | .. | 7.8 | .. | .310 |
| 11 | 4.7 | .. | 5.5 | .. | 6.3 | .. | 7.1 | .. | .375 |
| 12 | 4.3 | .. | 5.0 | .. | 5.8 | .. | 6.5 | .. | .447 |
| 13 | 4.0 | .. | 4.6 | .. | 5.4 | .. | 6.0 | .. | .525 |
| 14 | 3.7 | .. | 4.3 | .. | 5.0 | .. | 5.6 | .. | .608 |
| 15 | 3.5 | .. | 4.0 | .. | 4.6 | .. | 5.2 | .. | .698 |
| 16 | 3.3 | .. | 3.8 | .. | 4.3 | .. | 4.9 | .. | .795 |
| 17 | 3.1 | .. | 3.6 | .. | 4.1 | .. | 4.6 | .. | .898 |
| 18 | 2.9 | .. | 3.4 | .. | 3.8 | .. | 4.3 | .. | 1.01 |
| 19 | 2.7 | .. | 3.2 | .. | 3.6 | .. | 4.1 | .. | 1.12 |
| 20 | 2.6 | .. | 3.0 | .. | 3.5 | .. | 3.9 | .. | 1.24 |
| 21 | 2.5 | .. | 2.9 | .. | 3.3 | .. | 3.7 | .. | 1.37 |
| 22 | 2.4 | .. | 2.7 | .. | 3.1 | .. | 3.5 | .. | 1.51 |
| 23 | 2.3 | .. | 2.6 | .. | 3.0 | .. | 3.4 | .. | 1.64 |
| 24 | 2.2 | .. | 2.5 | .. | 2.9 | .. | 3.3 | .. | 1.79 |
| 25 | 2.1 | .. | 2.4 | .. | 2.8 | .. | 3.1 | .. | 1.94 |

# 7" [

## STANDARD CHANNELS

### DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
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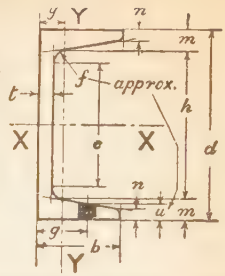
Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown




| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d" | | 7 | 7 | 7 | 7 | 7 |
| Wt. per foot | | 9.8 | 12.25 | 14.75 | 17.25 | 19.75 |
| Area, sq. in. | | 2.85 | 3.58 | 4.32 | 5.05 | 5.79 |
| b" | | 2.09 | 2.19 | 2.30 | 2.40 | 2.51 |
| t | | .210 | .314 | .419 | .524 | .629 |
| h | | 5.954 | 5.954 | 5.954 | 5.954 | 5.954 |
| m | | .523 | .523 | .523 | .523 | .523 |
| n | | .210 | .210 | .210 | .210 | .210 |
| f | | .310 | .310 | .310 | .310 | .310 |
| e | | 5.429 | 5.429 | 5.429 | 5.429 | 5.429 |
| g | | 1¼ | 1¼ | 1¼ | 1½ | 1½ |
| u | | ⅜ | ⅜ | 7/16 | 7/16 | 7/16 |
| AXES X-X | I | 21.1 | 24.1 | 27.1 | 30.1 | 33.1 |
| | S | 6.03 | 6.88 | 7.74 | 8.60 | 9.46 |
| | r | 2.72 | 2.59 | 2.51 | 2.44 | 2.39 |
| AXES Y-Y | I | 0.98 | 1.2 | 1.4 | 1.6 | 1.8 |
| | S | 0.63 | 0.71 | 0.79 | 0.86 | 0.96 |
| | r | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 |
| | y | 0.55 | 0.53 | 0.53 | 0.55 | 0.58 |
| Coef. Str | | 72300 | 82600 | 92900 | 103200 | 113500 |
| Max Mom "s | | 103500 | 123900 | 139400 | 154800 | 170200 |
| V | | 17600 | 23500 | 35200 | 44000 | 52800 |
| P feet | | 2.05 | 1.56 | 1.32 | 1.17 | 1.07 |
| W | | 9560 | 11900 | 11900 | 11900 | 11900 |
| Q feet | | 3.81 | 3.47 | 3.90 | 4.34 | 4.77 |
| w lbs | | 6 | 6 | 6 | 6 | 6 |
| Rivet dia | | ⅝ | ⅝ | ⅝ | ⅝ | ⅝ |

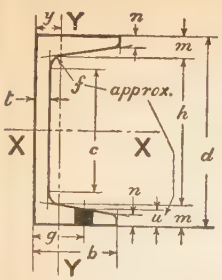
Live Load Deflection must not exceed 1-360 of the Span.

$$\text{LiveLoad Def.} = \frac{\text{Total Def.} \times \text{LiveLoad}}{\text{Tabular Load}}$$

Total Deflection in inches for Maximum Load, laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 35. | 35. | 35.8 | 35.8 | 70.1 | 70. | 88.0 | 88.0 | | | |
| 2 | 35.2 | 35. | 41.3 | 41. | 70.3 | 70. | 51.6 | 51.6 | 56.8 | 56.8 | |
| 3 | 24.1 | 23. | 27.6 | 27.6 | 31.0 | 30.7 | 34.4 | 34.4 | 37.8 | 37.8 | .024 |
| 4 | 18.1 | 15.9 | 20.7 | 18.5 | 23.2 | 21.0 | 25.8 | 23.9 | 28.4 | 23.7 | .043 |
| 5 | 14.5 | 11.7 | 16.5 | 13.1 | 18.6 | 15.1 | 20.6 | 17.4 | 22.7 | 19.6 | .067 |
| 6 | 12.1 | 8.5 | 13.8 | 10.0 | 15.5 | 11.1 | 17.2 | 13.2 | 18.9 | 14.9 | .096 |
| 7 | 10.3 | 6.4 | 11.8 | 7.6 | 13.3 | 8.9 | 14.7 | 10.1 | 16.2 | 13.6 | .130 |
| 8 | 9.0 | .. | 10.3 | .. | 11.6 | .. | 12.9 | 8.0 | 14.2 | 9.1 | .170 |
| 9 | 8.0 | .. | 9.2 | .. | 10.3 | .. | 11.5 | .. | 12.6 | .. | .216 |
| 10 | 7.2 | .. | 8.3 | .. | 9.3 | .. | 10.3 | .. | 11.4 | .. | .266 |
| 11 | 6.6 | .. | 7.5 | .. | 8.4 | .. | 9.4 | .. | 10.3 | .. | .321 |
| 12 | 6.0 | .. | 6.9 | .. | 7.7 | .. | 8.6 | .. | 9.5 | .. | .383 |
| 13 | 5.5 | .. | 6.4 | .. | 7.1 | .. | 7.9 | .. | 8.7 | .. | .450 |
| 14 | 5.1 | .. | 5.9 | .. | 6.6 | .. | 7.4 | .. | 8.1 | .. | .521 |
| 15 | 4.8 | .. | 5.5 | .. | 6.2 | .. | 6.9 | .. | 7.6 | .. | .599 |
| 16 | 4.5 | .. | 5.2 | .. | 5.8 | .. | 6.5 | .. | 7.1 | .. | .681 |
| 17 | 4.3 | .. | 4.9 | .. | 5.5 | .. | 6.1 | .. | 6.7 | .. | .770 |
| 18 | 4.0 | .. | 4.6 | .. | 5.2 | .. | 5.7 | .. | 6.3 | .. | .861 |
| 19 | 3.8 | .. | 4.3 | .. | 4.9 | .. | 5.4 | .. | 6.0 | .. | .960 |
| 20 | 3.6 | .. | 4.1 | .. | 4.6 | .. | 5.2 | .. | 5.7 | .. | 1.06 |
| 21 | 3.4 | .. | 3.9 | .. | 4.4 | .. | 4.9 | .. | 5.4 | .. | 1.17 |
| 22 | 3.3 | .. | 3.8 | .. | 4.2 | .. | 4.7 | .. | 5.2 | .. | 1.29 |
| 23 | 3.1 | .. | 3.6 | .. | 4.0 | .. | 4.4 | .. | 4.9 | .. | 1.41 |
| 24 | 3.0 | .. | 3.4 | .. | 3.9 | .. | 4.3 | .. | 4.7 | .. | 1.53 |
| 25 | 2.9 | .. | 3.3 | .. | 3.7 | .. | 4.1 | .. | 4.5 | .. | 1.66 |




# STANDARD CHANNELS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

8"

| Depth = d" | | 8 | 8 | 8 | 8 | 8 |
|---|---|---|---|---|---|---|
| Wt. per foot | | **11.50** | 13.75 | 16.25 | 18.75 | 21.25 |
| Area, sq. in. | | 3.36 | 4.02 | 4.76 | 5.49 | 6.23 |
| b" | | 2.26 | 2.34 | 2.44 | 2.53 | 2.62 |
| t | | .220 | .303 | .395 | .487 | .579 |
| h | | 6.880 | 6.880 | 6.880 | 6.880 | 6.880 |
| m | | .560 | .560 | .560 | .560 | .560 |
| n | | .220 | .220 | .220 | .220 | .220 |
| f | | .320 | .320 | .320 | .320 | .320 |
| c | | 6.338 | 6.338 | 6.338 | 6.338 | 6.338 |
| g | | 1⅜ | 1⅜ | 1½ | 1½ | 1½ |
| u | | ⅜ | ⅜ | 7/16 | 7/16 | 7/16 |
| AXES X-X | I | 32.3 | 35.8 | 39.8 | 43.7 | 47.6 |
| | S | 8.08 | 8.95 | 9.95 | 10.92 | 11.9 |
| | r | 3.10 | 2.99 | 2.89 | 2.82 | 2.77 |
| AXES Y-Y | I | 1.3 | 1.5 | 1.8 | 2.0 | 2.2 |
| | S | .79 | .86 | .94 | 1.0 | 1.1 |
| | r | .63 | .62 | .61 | .60 | .60 |
| | y | .58 | .56 | .56 | .57 | .59 |
| Coef. Str. | | 96900 | 107400 | 119400 | 131100 | 142800 |
| Max. Mom." # | | 145400 | 161100 | 179100 | 196700 | 214200 |
| V | | 21100 | 29100 | 37900 | 46800 | 55600 |
| P, feet | | 2.30 | 1.80 | 1.58 | 1.40 | 1.28 |
| W | | 19800 | 23800 | 23800 | 23800 | 23800 |
| Q, feet | | 2.45 | 2.26 | 2.51 | 2.75 | 3.00 |
| w, lbs. | | 13 | 13 | 13 | 13 | 13 |
| Rivet dia. | | ¾ | ¾ | ¾ | ¾ | ¾ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{LiveLoadDef.} = \frac{\text{Total Def.} \times \text{LiveLoad}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load, laterally fixed beam |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 42.2 | 42.2 | 58.2 | 58.2 | 75.8 | 75.8 | 93.6 | 93.6 | | | |
| 2 | 42.2 | 42.2 | 53.7 | 53.7 | 59.7 | 59.7 | 65.6 | 65.6 | 71.4 | 71.4 | |
| 3 | 32.3 | 31.9 | 35.8 | 35.6 | 39.8 | 39.8 | 43.7 | 43.7 | 47.6 | 47.6 | .021 |
| 4 | 24.2 | 22.0 | 26.9 | 24.7 | 29.8 | 27.7 | 32.8 | 30.9 | 35.7 | 34.0 | .037 |
| 5 | 19.4 | 15.9 | 21.5 | 18.0 | 23.9 | 20.4 | 26.3 | 22.8 | 28.6 | 25.2 | .058 |
| 6 | 16.1 | 12.0 | 17.9 | 13.5 | 19.9 | 15.4 | 21.9 | 17.3 | 23.8 | 19.2 | .084 |
| 7 | 13.8 | 9.0 | 15.3 | 10.3 | 17.1 | 12.0 | 18.7 | 13.4 | 20.4 | 15.0 | .114 |
| 8 | 12.1 | .. | 13.4 | .. | 14.9 | 9.3 | 16.4 | 10.6 | 17.9 | 11.9 | .149 |
| 9 | 10.8 | .. | 11.9 | .. | 13.3 | .. | 14.5 | .. | 15.9 | .. | .189 |
| 10 | 9.7 | .. | 10.7 | .. | 11.9 | .. | 13.1 | .. | 14.3 | .. | .233 |
| 11 | 8.8 | .. | 9.8 | .. | 10.8 | .. | 11.9 | .. | 13.0 | .. | .281 |
| 12 | 8.1 | .. | 8.9 | .. | 9.9 | .. | 10.9 | .. | 11.9 | .. | .335 |
| 13 | 7.5 | .. | 8.3 | .. | 9.1 | .. | 10.1 | .. | 11.0 | .. | .394 |
| 14 | 6.9 | .. | 7.7 | .. | 8.5 | .. | 9.3 | .. | 10.2 | .. | .456 |
| 15 | 6.5 | .. | 7.2 | .. | 7.9 | .. | 8.7 | .. | 9.5 | .. | .524 |
| 16 | 6.1 | .. | 6.8 | .. | 7.4 | .. | 8.2 | .. | 8.9 | .. | .596 |
| 17 | 5.7 | .. | 6.4 | .. | 7.0 | .. | 7.7 | .. | 8.4 | .. | .674 |
| 18 | 5.4 | .. | 6.0 | .. | 6.6 | .. | 7.3 | .. | 7.9 | .. | .754 |
| 19 | 5.1 | .. | 5.7 | .. | 6.3 | .. | 6.9 | .. | 7.5 | .. | .840 |
| 20 | 4.8 | .. | 5.4 | .. | 6.0 | .. | 6.6 | .. | 7.1 | .. | .931 |
| 21 | 4.6 | .. | 5.1 | .. | 5.7 | .. | 6.2 | .. | 6.8 | .. | 1.03 |
| 22 | 4.4 | .. | 4.9 | .. | 5.4 | .. | 6.0 | .. | 6.5 | .. | 1.13 |
| 23 | 4.2 | .. | 4.7 | .. | 5.2 | .. | 5.7 | .. | 6.2 | .. | 1.23 |
| 24 | 4.0 | .. | 4.5 | .. | 5.0 | .. | 5.5 | .. | 6.0 | .. | 1.34 |
| 25 | 3.9 | .. | 4.3 | .. | 4.8 | .. | 5.2 | .. | 5.7 | .. | 1.46 |

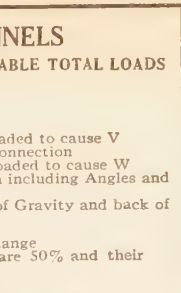
9"

# STANDARD CHANNELS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



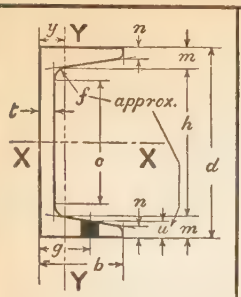

| Depth = d″ | 9 | 9 | 9 | 9 |
|---|---|---|---|---|
| Wt. per foot | **13.4** | 15.0 | 20.0 | 25.0 |
| Area, sq. in. | 3.89 | 4.39 | 5.86 | 7.33 |
| b″ | 2.43 | 2.49 | 2.65 | 2.81 |
| t | .230 | .285 | .448 | .612 |
| h | 7.806 | 7.806 | 7.806 | 7.806 |
| m | .597 | .597 | .597 | .597 |
| n | .230 | .230 | .230 | .230 |
| f | .330 | .330 | .330 | .330 |
| c | 7.247 | 7.247 | 7.247 | 7.247 |
| g | 1⅜ | 1⅜ | 1½ | 1½ |
| u | 7/16 | 7/16 | ½ | ½ |
| AXES X-X I | 47.3 | 50.7 | 69.6 | 70.5 |
| AXES X-X S | 10.51 | 11.27 | 13.47 | 15.66 |
| AXES X-X r | 3.49 | 3.40 | 3.22 | 3.10 |
| AXES Y-Y I | 1.8 | 1.9 | 2.4 | 3.0 |
| AXES Y-Y S | 0.97 | 1.0 | 1.2 | 1.4 |
| AXES Y-Y r | .67 | .67 | .65 | .64 |
| AXES Y-Y y | .61 | .59 | .59 | .61 |
| Coef. Str. | 126100 | 135200 | 161600 | 188000 |
| Max. Mom.″ # | 189200 | 202800 | 242400 | 282000 |
| V | 24800 | 30800 | 48500 | 66100 |
| P, feet | 2.51 | 2.19 | 1.67 | 1.12 |
| W | 20700 | 23800 | 23800 | 23800 |
| Q, feet | 3.05 | 2.84 | 3.39 | 3.95 |
| w, lbs | 13 | 13 | 13 | 13 |
| Rivet dia. | ¾ | ¾ | ¾ | ¾ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | free | Laterally fixed | free | Laterally fixed | free | Laterally fixed | free | Total Deflection in inches for Maximum Load; laterally fixed beam |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 49.6 | 49.6 | 51.6 | 51.6 | 97.0 | 97.0 | 132 | 132 | |
| 2 | 49.6 | 49.6 | 51.6 | 51.6 | 89.8 | 80.8 | 91.0 | 91.0 | |
| 3 | 42.0 | 42.0 | 45.1 | 45.1 | 53.9 | 53.9 | 52.7 | 52.7 | .019 |
| 4 | 31.5 | 29.3 | 33.8 | 31.7 | 40.4 | 38.6 | 47.0 | 45.5 | .033 |
| 5 | 25.2 | 21.5 | 27.0 | 23.0 | 32.3 | 28.6 | 37.6 | 34.1 | .052 |
| 6 | 21.0 | 16.2 | 22.5 | 17.6 | 26.9 | 21.8 | 31.3 | 26.2 | .074 |
| 7 | 18.0 | 12.5 | 19.4 | 13.4 | 23.1 | 17.1 | 26.9 | 20.6 | .101 |
| 8 | 15.8 | 9.9 | 16.9 | 10.7 | 20.2 | 13.6 | 23.5 | 16.5 | .133 |
| 9 | 14.0 | | 15.0 | | 18.0 | | 21.0 | 13.4 | .168 |
| 10 | 12.6 | | 13.5 | | 16.2 | | 18.8 | | .207 |
| 11 | 11.5 | | 12.3 | | 14.7 | | 17.1 | | .250 |
| 12 | 10.5 | | 11.3 | | 13.5 | | 15.7 | | .298 |
| 13 | 9.7 | | 10.4 | | 12.4 | | 14.5 | | .350 |
| 14 | 9.0 | | 9.7 | | 11.5 | | 13.4 | | .406 |
| 15 | 8.4 | | 9.0 | | 10.8 | | 12.5 | | .466 |
| 16 | 7.9 | | 8.4 | | 10.2 | | 11.8 | | .530 |
| 17 | 7.4 | | 8.0 | | 9.5 | | 11.1 | | .599 |
| 18 | 7.0 | | 7.5 | | 9.0 | | 10.4 | | .670 |
| 19 | 6.6 | | 7.1 | | 8.5 | | 9.9 | | .747 |
| 20 | 6.3 | | 6.8 | | 8.1 | | 9.4 | | .828 |
| 21 | 6.0 | | 6.4 | | 7.7 | | 9.0 | | .912 |
| 22 | 5.7 | | 6.1 | | 7.3 | | 8.5 | | 1.00 |
| 23 | 5.5 | | 5.9 | | 7.0 | | 8.2 | | 1.10 |
| 24 | 5.3 | | 5.6 | | 6.7 | | 7.8 | | 1.19 |
| 25 | 5.0 | | 5.4 | | 6.5 | | 7.5 | | 1.29 |




# STANDARD CHANNELS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

**10"**

| Depth = d" | | 10 | 10 | 10 | 10 | 10 |
|---|---|---|---|---|---|---|
| Wt. per foot | | 15.3 | 20.0 | 25.0 | 30.0 | 35.0 |
| Area, sq. in. | | 4.47 | 5.86 | 7.33 | 8.80 | 10.27 |
| b" | | 2.60 | 2.74 | 2.89 | 3.03 | 3.18 |
| t | | .240 | .379 | .526 | .673 | .820 |
| h | | 8.734 | 8.734 | 8.734 | 8.734 | 8.734 |
| m | | .633 | .633 | .633 | .633 | .633 |
| n | | .240 | .240 | .240 | .240 | .240 |
| f | | .340 | .340 | .340 | .340 | .340 |
| c | | 8.158 | 8.158 | 8.158 | 8.158 | 8.158 |
| g | | 1½ | 1½ | 1¾ | 1¾ | 1¾ |
| u | | 7/16 | 7/16 | ½ | ½ | ½ |
| AXES X-X | I | 66.9 | 78.5 | 90.7 | 103.0 | 115.2 |
| | S | 13.38 | 15.7 | 18.14 | 20.6 | 23.04 |
| | r | 3.87 | 3.66 | 3.52 | 3.42 | 3.34 |
| AXES Y-Y | I | 2.3 | 2.8 | 3.4 | 4.0 | 4.6 |
| | S | 1.2 | 1.3 | 1.5 | 1.7 | 1.9 |
| | r | .72 | .70 | .68 | .67 | .67 |
| | y | .64 | .61 | .62 | .65 | .69 |
| Coef. Str. | | 160600 | 188400 | 217700 | 247200 | 276500 |
| Max. Mom." | | 240900 | 282600 | 326500 | 370800 | 414700 |
| V | | 28800 | 45500 | 63100 | 80800 | 98400 |
| P, feet | | 2.79 | 2.07 | 1.73 | 1.53 | 1.41 |
| W | | 21600 | 23800 | 23800 | 23800 | 23800 |
| Q, feet | | 3.72 | 3.96 | 4.57 | 5.19 | 5.81 |
| w, lbs. | | 13 | 13 | 13 | 13 | 13 |
| Rivet dia | | ¾ | ¾ | ¾ | ¾ | ¾ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 58 | 58 | 91 | 91 | 126 | 126 | 162 | 162 | 197 | 197 | |
| 2 | 58 | 58 | 91 | 91 | 109 | 109 | 124 | 124 | 138 | 138 | |
| 3 | 54 | 54 | 63 | 63 | 73 | 73 | 82 | 82 | 92 | 92 | .017 |
| 4 | 40 | 38 | 47 | 45 | 54 | 53 | 62 | 61 | 69 | 69 | .030 |
| 5 | 32 | 28 | 38 | 34 | 44 | 40 | 49 | 46 | 55 | 52 | .047 |
| 6 | 27 | 22 | 31 | 26 | 36 | 31 | 41 | 36 | 46 | 41 | .067 |
| 7 | 23 | 17 | 27 | 20 | 31 | 24 | 35 | 28 | 40 | 33 | .091 |
| 8 | 20 | 14 | 24 | 16 | 27 | 20 | 31 | 23 | 35 | 26 | .119 |
| 9 | 18 | ... | 21 | 13 | 24 | 16 | 28 | 19 | 31 | 22 | .151 |
| 10 | 16 | ... | 19 | . | 22 | .. | 25 | 15 | 28 | 18 | .186 |
| 11 | 15 | .. | 17 | . | 20 | .. | 23 | ... | 25 | ... | .225 |
| 12 | 13 | ... | 16 | ... | 18 | ... | 21 | ... | 23 | ... | .268 |
| 13 | 12 | ... | 15 | ... | 17 | ... | 19 | ... | 21 | .. | .315 |
| 14 | 12 | ... | 14 | ... | 16 | ... | 18 | ... | 20 | ... | .365 |
| 15 | 11 | ... | 13 | ... | 15 | ... | 17 | ... | 18 | ... | .419 |
| 16 | 10 | ... | 12 | ... | 14 | ... | 16 | ... | 17 | ... | .477 |
| 17 | 9 | ... | 11 | ... | 13 | ... | 15 | ... | 16 | ... | .539 |
| 18 | 9 | ... | 11 | .. | 12 | .. | 14 | ... | 15 | ... | .603 |
| 19 | 8 | ... | 10 | ... | 12 | ... | 13 | ... | 15 | ... | .672 |
| 20 | 8 | ... | 9 | ... | 11 | ... | 12 | ... | 14 | ... | .745 |
| 21 | 8 | ... | 9 | ... | 10 | ... | 12 | ... | 13 | ... | .821 |
| 22 | 7 | ... | 8 | ... | 10 | ... | 11 | ... | 13 | ... | .901 |
| 23 | 7 | ... | 8 | ... | 10 | ... | 11 | ... | 12 | ... | .986 |
| 24 | 7 | ... | 8 | ... | 9 | ... | 10 | ... | 12 | ... | 1.07 |
| 25 | 6 | ... | 8 | ... | 9 | ... | 10 | ... | 11 | ... | 1.16 |

# 12" [

## STANDARD CHANNELS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
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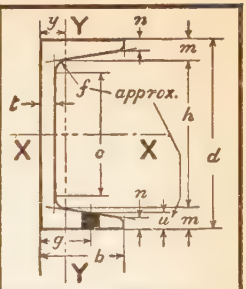
Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



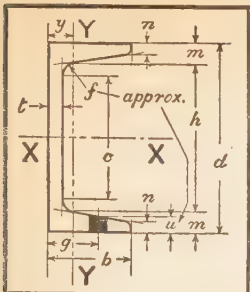

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″ | | | 12 | | 12 | | 12 | | 12 | | 12 | |
| Wt. per foot | | | **20.7** | | 25.0 | | 30.0 | | 35.0 | | 40.0 | |
| Area, sq. in. | | | 6.03 | | 7.32 | | 8.79 | | 10.26 | | 1..73 | |
| b″ | | | 2.94 | | 3.05 | | 3.17 | | 3.29 | | 3.42 | |
| t | | | .280 | | .387 | | .510 | | .632 | | .755 | |
| h | | | 10.554 | | 10.554 | | 10.554 | | 10.554 | | 10.554 | |
| m | | | .723 | | .723 | | .723 | | .723 | | .723 | |
| n | | | .280 | | .280 | | .280 | | .280 | | .280 | |
| f | | | .380 | | .380 | | .380 | | .380 | | .380 | |
| c | | | 9.910 | | 9.910 | | 9.910 | | 9.910 | | 9.910 | |
| g | | | 1¾ | | 1¾ | | 1¾ | | 2 | | 2 | |
| u | | | ½ | | ½ | | ½ | | ⅝ | | ⅝ | |
| AXES | X-X | I | 128.1 | | 143.5 | | 161.2 | | 178.8 | | 196.5 | |
| | | S | 21.35 | | 23.92 | | 26.87 | | 29.8 | | 32.75 | |
| | | r | 4.61 | | 4.43 | | 4.28 | | 4.18 | | 4.09 | |
| | Y-Y | I | 3.9 | | 4.5 | | 5.2 | | 5.9 | | 6.6 | |
| | | S | 1.7 | | 1.9 | | 2.1 | | 2.3 | | 2.5 | |
| | | r | .81 | | .79 | | .77 | | .76 | | .75 | |
| | | y | .70 | | .68 | | .68 | | .69 | | .72 | |
| Coef. Str. | | | 256200 | | 287000 | | 322400 | | 357600 | | 393000 | |
| Max. Mom." # | | | 384300 | | 430500 | | 483600 | | 536400 | | 589500 | |
| V | | | 40300 | | 55700 | | 73400 | | 91000 | | 108700 | |
| P. feet | | | 3.18 | | 2.58 | | 2.20 | | 1.96 | | 1.81 | |
| W | | | 23860 | | 23860 | | 23860 | | 23860 | | 23860 | |
| Q. feet | | | 5.37 | | 6.01 | | 6.76 | | 7.49 | | 8.24 | |
| w. lbs. | | | 13 | | 13 | | 13 | | 13 | | 13 | |
| Rivet dia. | | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ | |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 81 | 81 | 111 | 111 | 147 | 147 | 182 | 182 | 217 | 217 | |
| 2 | 81 | 81 | 111 | 111 | 147 | 147 | 179 | 179 | 197 | 197 | |
| 3 | 81 | 81 | 96 | 96 | 108 | 108 | 119 | 119 | 131 | 131 | .014 |
| 4 | 64 | 63 | 72 | 71 | 81 | 80 | 89 | 89 | 98 | 98 | .025 |
| 5 | 51 | 47 | 57 | 53 | 65 | 61 | 72 | 68 | 79 | 76 | .039 |
| 6 | 43 | 37 | 48 | 42 | 54 | 47 | 60 | 53 | 66 | 60 | .056 |
| 7 | 37 | 29 | 41 | 33 | 46 | 38 | 51 | 43 | 56 | 48 | .076 |
| 8 | 32 | 23 | 36 | 27 | 40 | 31 | 45 | 35 | 49 | 39 | .099 |
| 9 | 28 | 19 | 32 | 22 | 36 | 25 | 40 | 29 | 44 | 32 | .126 |
| 10 | 26 | ... | 29 | 18 | 32 | 21 | 36 | 24 | 39 | 27 | .155 |
| 11 | 23 | ... | 26 | ... | 29 | ... | 33 | ... | 36 | 23 | .188 |
| 12 | 21 | ... | 24 | ... | 27 | ... | 30 | ... | 33 | ... | .223 |
| 13 | 20 | ... | 22 | ... | 25 | ... | 28 | ... | 30 | ... | .263 |
| 14 | 18 | ... | 21 | ... | 23 | ... | 26 | ... | 28 | ... | .304 |
| 15 | 17 | ... | 19 | ... | 22 | ... | 24 | ... | 26 | ... | .341 |
| 16 | 16 | ... | 18 | ... | 20 | ... | 22 | ... | 25 | ... | .398 |
| 17 | 15 | ... | 17 | ... | 19 | ... | 21 | ... | 23 | ... | .449 |
| 18 | 14 | ... | 16 | ... | 18 | ... | 20 | ... | 22 | ... | .503 |
| 19 | 13 | ... | 15 | ... | 17 | ... | 19 | ... | 21 | ... | .560 |
| 20 | 13 | ... | 14 | ... | 16 | ... | 18 | ... | 20 | ... | .621 |
| 21 | 12 | ... | 14 | ... | 15 | ... | 17 | ... | 19 | ... | .684 |
| 22 | 12 | ... | 13 | ... | 15 | ... | 16 | ... | 18 | ... | .751 |
| 23 | 11 | ... | 13 | ... | 14 | ... | 16 | ... | 17 | ... | .822 |
| 24 | 11 | ... | 12 | ... | 13 | ... | 15 | ... | 16 | ... | .894 |
| 25 | 10 | ... | 12 | ... | 13 | ... | 14 | ... | 16 | ... | .970 |
| 26 | 10 | ... | 11 | ... | 12 | ... | 14 | ... | 15 | ... | 1.050 |




# STANDARD CHANNELS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets
y is Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 15"

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d" | | 15 | 15 | 15 | 15 | 15 | 15 |
| Wt. per foot... | | **33.9** | 35.0 | 40.0 | 45.0 | 50.0 | 55.0 |
| Area. sq. in... | | 9.90 | 10.23 | 11.70 | 13.17 | 14.64 | 16.11 |
| b"..... | | 3.40 | 3.42 | 3.52 | 3.62 | 3.72 | 3.81 |
| t..... | | .400 | .422 | .520 | .618 | .716 | .814 |
| h..... | | 13.200 | 13.200 | 13.200 | 13.200 | 13.200 | 13.200 |
| m..... | | .900 | .900 | .900 | .900 | .900 | .900 |
| n..... | | .400 | .400 | .400 | .400 | .400 | .400 |
| f..... | | .50 | .50 | .50 | .50 | .50 | .50 |
| c..... | | 12.353 | 12.353 | 12.353 | 12.353 | 12.353 | 12.353 |
| g..... | | 2 | 2 | 2 | 2 | 2½ | 2½ |
| u..... | | ⅝ | ⅝ | ⅝ | ⅝ | 11/16 | 11/16 |
| AXES X-X | I:... | 312.6 | 318.7 | 346.3 | 373.9 | 401.4 | 429.0 |
| | S.... | 41.68 | 42.49 | 46.17 | 49.85 | 53.52 | 57.2 |
| | r.... | 5.62 | 5.58 | 5.44 | 5.33 | 5.24 | 5.16 |
| AXES Y-Y | I.... | 8.2 | 8.4 | 9.3 | 10.3 | 11.2 | 12.1 |
| | S.... | 3.2 | 3.2 | 3.4 | 3.6 | 3.8 | 4.1 |
| | r.... | .91 | .91 | .89 | .88 | .87 | .87 |
| | y.... | .79 | .79 | .78 | .79 | .80 | .82 |
| Coef. Str..... | | 500200 | 509900 | 554100 | 598200 | 642200 | 686400 |
| Max.Mom." # | | 750300 | 764900 | 831100 | 897300 | 963400 | 1029600 |
| V..... | | 72000 | 76000 | 93600 | 111200 | 128900 | 146500 |
| P. feet... | | 3.47 | 3.35 | 2.96 | 2.69 | 2.49 | 2.34 |
| W..... | | 36000 | 38000 | 46800 | 47700 | 47700 | 47700 |
| Q. feet... | | 6.95 | 6.71 | 5.92 | 6.27 | 6.73 | 7.19 |
| w. lbs.... | | 19 | 19 | 19 | 19 | 19 | 19 |
| Rivet dia..... | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ |

Live Load Deflection must not exceed 1-360 of the Span. Live Load Def. f. = $\frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$

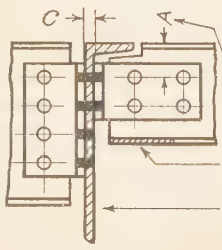
Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 144 | 144 | 152 | 152 | 187 | 187 | 222 | 222 | 258 | 258 | 293 | 293 | |
| 2 | 144 | 144 | 152 | 152 | 187 | 187 | 222 | 222 | 258 | 258 | 293 | 293 | |
| 3 | 144 | 144 | 152 | 152 | 187 | 185 | 199 | 199 | 214 | 214 | 229 | 229 | .011 |
| 4 | 125 | 125 | 128 | 127 | 139 | 138 | 150 | 150 | 161 | 161 | 172 | 172 | .020 |
| 5 | 100 | 96 | 102 | 98 | 111 | 108 | 120 | 117 | 128 | 126 | 137 | 136 | .031 |
| 6 | 83 | 76 | 85 | 77 | 92 | 85 | 100 | 93 | 107 | 100 | 114 | 108 | .045 |
| 7 | 71 | 61 | 73 | 62 | 79 | 69 | 86 | 75 | 92 | 81 | 98 | 88 | .061 |
| 8 | 63 | 50 | 64 | 51 | 69 | 56 | 75 | 62 | 80 | 67 | 86 | 72 | .079 |
| 9 | 56 | 41 | 57 | 42 | 62 | 47 | 67 | 51 | 72 | 56 | 76 | 61 | .101 |
| 10 | 50 | 34 | 51 | 35 | 55 | 39 | 60 | 43 | 64 | 47 | 69 | 51 | .124 |
| 11 | 45 | 29 | 46 | 30 | 50 | 33 | 54 | 36 | 58 | 40 | 62 | 43 | .150 |
| 12 | 42 | .. | 43 | .. | 46 | .. | 50 | 30 | 54 | 34 | 57 | 37 | .179 |
| 13 | 39 | .. | 39 | .. | 43 | .. | 46 | .. | 49 | .. | 53 | .. | .210 |
| 14 | 36 | .. | 36 | .. | 40 | .. | 43 | .. | 46 | .. | 49 | .. | .243 |
| 15 | 33 | .. | 34 | .. | 37 | .. | 40 | .. | 43 | .. | 46 | .. | .279 |
| 16 | 31 | .. | 32 | .. | 35 | .. | 37 | .. | 40 | .. | 43 | .. | .318 |
| 17 | 29 | .. | 30 | .. | 33 | .. | 35 | .. | 38 | .. | 41 | .. | .359 |
| 18 | 28 | .. | 28 | .. | 31 | .. | 33 | .. | 36 | .. | 39 | .. | .402 |
| 19 | 26 | .. | 27 | .. | 29 | .. | 32 | .. | 34 | .. | 36 | .. | .448 |
| 20 | 25 | .. | 26 | .. | 28 | .. | 30 | .. | 32 | .. | 34 | .. | .497 |
| 21 | 24 | .. | 24 | .. | 26 | .. | 29 | .. | 31 | .. | 33 | .. | .547 |
| 22 | 23 | .. | 23 | .. | 25 | .. | 27 | .. | 29 | .. | 31 | .. | .601 |
| 23 | 22 | .. | 22 | .. | 24 | .. | 26 | .. | 28 | .. | 30 | .. | .651 |
| 24 | 21 | .. | 21 | .. | 23 | .. | 25 | .. | 27 | .. | 29 | .. | .715 |
| 25 | 20 | .. | 20 | .. | 22 | .. | 24 | .. | 26 | .. | 28 | .. | .776 |
| 26 | 19 | .. | 20 | .. | 21 | .. | 23 | .. | 25 | .. | 26 | .. | .839 |
| 27 | 19 | .. | 19 | .. | 21 | .. | 22 | .. | 24 | .. | 25 | .. | .909 |
| 28 | 18 | .. | 18 | .. | 20 | .. | 21 | .. | 23 | .. | 25 | .. | .973 |
| 29 | 17 | .. | 18 | .. | 19 | .. | 21 | .. | 22 | .. | 24 | .. | 1.040 |
| 30 | 17 | .. | 17 | .. | 19 | .. | 20 | .. | 21 | .. | 23 | .. | 1.120 |
| 31 | 16 | .. | 16 | .. | 18 | .. | 19 | .. | 21 | .. | 22 | .. | 1.190 |
| 32 | 16 | .. | 16 | .. | 17 | .. | 19 | .. | 20 | .. | 22 | .. | 1.270 |

# CONNECTION ANGLES FOR AMERICAN STANDARD CHANNELS

DIMENSIONS, WEIGHTS, AND WORKING LOADS. 3/4" POWER DRIVEN RIVETS.

| Channel | | Connection Value | | | Framing Distance | Connection Angles | | | | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Outstanding Single Shear | | | | | | | |
| Depth | Weight per foot | Web | Power Driven Rivets | Unfinished Bolts | C | A.I.S.C. Mark | Gage g | Size and Length | Weight inc. Web Rivets | |
| 3" | 4.1 | 7650 | 11930 | 8840 | 1/4 | IC. 5.11 | 2 11/16 | 6" × 4" × 3/8" 0' — 2" Long | 5 lbs. | |
| | 5.0 | 11610 | " | " | 5/16 | IC. 5.10 | 2 5/8 | | | |
| | 6.0 | 16020 | " | " | 7/16 | IC. 5. 9 | 2 9/16 | | | |
| 4" | 5.4 | 8100 | 11930 | 8840 | 1/4 | IC. 5.11 | 2 11/16 | | | |
| | 6.25 | 11120 | " | " | 5/16 | IC. 5.10 | 2 5/8 | | | |
| | 7.25 | 14400 | " | " | 3/8 | IC. 5. 9 | 2 9/16 | | | |
| 5" | 6.7 | 8550 | 11930 | 8840 | 1/4 | IC. 6.10 | 2 5/8 | 6" × 4" × 3/8" 0' — 2 1/2" Long | 6 lbs. | |
| | 9.0 | 14630 | " | " | 3/8 | IC. 6. 9 | 2 9/16 | | | |
| | 11.5 | 21240 | " | " | 9/16 | IC. 6. 8 | 2 1/2 | | | |
| 6" | 8.2 | 9000 | 11930 | 8840 | 1/4 | IC. 6.10 | 2 5/8 | | | |
| | 10.5 | 14130 | " | " | 3/8 | IC. 6. 9 | 2 9/16 | | | |
| | 13 0 | 19670 | " | " | 1/2 | IC. 6. 9 | 2 9/16 | | | |
| | 15.5 | 23860 | " | " | 5/8 | IC. 6. 8 | 2 1/2 | | | |
| 7" | 9 8 | 9450 | 11930 | 8840 | 1/4 | IC. 6.10 | 2 5/8 | | | |
| | 12 25 | 14130 | " | " | 3/8 | IC. 6. 9 | 2 9/16 | | | |
| | 14 75 | 18860 | " | " | 1/2 | IC. 6. 9 | 2 9/16 | | | |
| | 17.25 | 23580 | " | " | 9/16 | IC. 6. 8 | 2 1/2 | | | |
| | 19.75 | 23860 | " | " | 11/16 | IC. 6. 7 | 2 7/16 | | | |
| 8" | 11 5 | 19800 | 23860 | 17670 | 5/16 | IC.13 10 | 2 5/8 | 6" × 4" × 3/8" 0' — 5 1/2" Long | 13 lbs. | |
| | 13 75 | 27270 | " | " | 3/8 | IC.13 10 | 2 5/8 | | | |
| | 16.25 | 35550 | " | " | 7/16 | IC 13. 9 | 2 9/16 | | | |
| | 18 75 | 43830 | " | " | 9/16 | IC.13 8 | 2 1/2 | | | |
| | 21.25 | 47720 | " | " | 5/8 | IC.13. 7 | 2 7/16 | | | |
| 9" | 13 4 | 20700 | 23860 | 17670 | 5/16 | IC 13 10 | 2 5/8 | | | |
| | 15.0 | 25650 | " | " | 3/8 | IC.13 10 | 2 5/8 | | | |
| | 20 0 | 40320 | " | " | 1/2 | IC.13. 8 | 2 1/2 | | | |
| | 25.0 | 47720 | " | " | 11/16 | IC.13. 7 | 2 7/16 | | | |
| 10" | 15 3 | 21600 | 23860 | 17670 | 5/16 | IC.13.10 | 2 5/8 | | | |
| | 20 0 | 34100 | " | " | 7/16 | IC.13. 9 | 2 9/16 | | | |
| | 25 0 | 47340 | " | " | 9/16 | IC.13. 8 | 2 1/2 | | | |
| | 30.0 | 47720 | " | " | 3/4 | IC.13. 7 | 2 7/16 | | | |
| | 35 0 | " | " | " | 7/8 | IC.13. 6 | 2 3/8 | | | |
| 12" | 20 7 | 25200 | 23860 | 17670 | 5/16 | IC.13.10 | 2 5/8 | | | |
| | 25.0 | 34830 | " | " | 7/16 | IC.13. 9 | 2 9/16 | | | |
| | 30 0 | 45900 | " | " | 9/16 | IC.13. 8 | 2 1/2 | | | |
| | 35 0 | 47720 | " | " | 11/16 | IC.13. 7 | 2 7/16 | | | |
| | 40 0 | " | " | " | 13/16 | IC.13. 6 | 2 3/8 | | | |
| 15" | 33 9 | 36000 | 47720 | 35340 | 7/16 | IC 19. 9 | 2 9/16 | 4" × 3 1/2" × 3/8" 0' — 11 1/2" Long | 19 lbs. | |
| | 35 0 | 37980 | " | " | 1/2 | IC.19. 9 | 2 9/16 | | | |
| | 40.0 | 46800 | " | " | 9/16 | IC.19. 8 | 2 1/2 | | | |
| | 45 0 | 47720 | 47720 | 35340 | 11/16 | IC.19. 7 | 2 7/16 | | | |
| | 50 0 | " | " | " | 3/4 | IC 19. 6 | 2 3/8 | | | |
| | 55.0 | " | " | " | 7/8 | IC 19. 5 | 2 5/16 | | | |




*Layer-out starts with this dimension at left end of beam. With beams ordered one inch short, as usual in standard shop practice, this leaves sufficient end distance or clearance at right end, in case of full allowable 3/8" underrun or 3/8" overrun in beam lengths.

When A = 3" all beams and channels from 24" 100 lb. to 5" inclusive, can be framed opposite with tops flush.

When A = 3 1/4" all beams and channels from 24" 120 lb. to 6" inclusive, excepting 8", can be framed opposite with tops flush.

Flange must be cut away as shown, for field riveting, on all beams (excepting 5" and 8") framing opposite a larger beam which has a different size standard connection.

Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

# Part IV
# Section 4

## American Standard Beams

**Dimensions**

**Technical Functions**

**Allowable Total Loads**
**by**
**A. I. S. C. Specification**

**Allowable End Reactions**

**Standard Connection Angles**

| Usual Stock Sizes | |
|---|---|
| Depth | Weight |
| 3″ | 5.7 # |
| 4 | 7.7 |
| 5 | 10.0 |
| 6 | 12.5 |
| 7 | 15.3 |
| 8 | 18.4 |
| 9 | 21.8 |
| 10 | 25.4 |
| 12 | 31.8 |
| 15 | 42.9 |
| 18 | 54.7 |
| 20 | 65.4 |
| 24 | 79.9 |

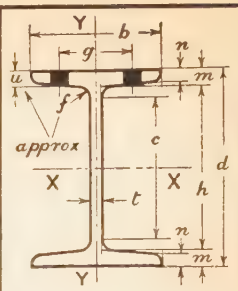
# 3" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown




| | | | | |
|---|---|---|---|---|
| Depth = d" | | 3 | 3 | 3 |
| Wt. per foot | | 5.7 | 6.5 | 7.5 |
| Area, sq. in. | | 1.64 | 1.88 | 2.17 |
| b" | | 2.33 | 2.41 | 2.51 |
| t | | .170 | .251 | .349 |
| h | | 2.300 | 2.300 | 2.300 |
| m | | .350 | .350 | .350 |
| n | | .170 | .170 | .170 |
| f | | .270 | .270 | .270 |
| c | | 1.843 | 1.843 | 1.843 |
| g | | 1½ | 1½ | 1½ |
| u | | 5/16 | 5/16 | 5/16 |
| AXES X-X | I | 2.5 | 2.7 | 2.9 |
| | S | 1.67 | 1.80 | 1.93 |
| | r | 1.23 | 1.19 | 1.15 |
| AXES Y-Y | I | 0.46 | 0.51 | 0.59 |
| | S | 0.40 | 0.43 | 0.47 |
| | r | 0.53 | 0.52 | 0.52 |
| Coef. Str. | | 20000 | 21600 | 23200 |
| Max. Mom." # | | 30000 | 32400 | 34800 |
| V | | 6100 | 9000 | 12600 |
| P. feet | | 1.64 | 1.20 | 0.92 |
| R | | 6100 | 9000 | 12600 |
| W | | 7650 | 11300 | 11900 |
| Q. feet | | 1.31 | 0.96 | 0.97 |
| w. lbs. | | 5 | 5 | 5 |
| Rivet dia. | | 3/8 | 3/8 | 3/8 |

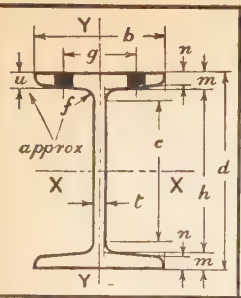
Live Load Deflection must not exceed 1-360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Total Deflection in inches for Maximum Load; laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 1 | 12.2 | 12.2 | 18.0 | 18.0 | 23.2 | 23.2 | |
| 2 | 10.0 | 10.0 | 10.8 | 10.8 | 11.6 | 11.6 | .025 |
| 3 | 6.7 | 6.6 | 7.2 | 7.2 | 7.7 | 7.7 | .056 |
| 4 | 5.0 | 4.6 | 5.4 | 5.0 | 5.8 | 5.5 | .099 |
| 5 | 4.0 | 3.3 | 4.3 | 3.6 | 4.6 | 4.0 | .155 |
| 6 | 3.3 | 2.5 | 3.6 | 2.8 | 3.9 | 3.1 | .223 |
| 7 | 2.9 | 1.9 | 3.1 | 2.1 | 3.3 | 2.3 | .304 |
| 8 | 2.5 | .. | 2.7 | 1.7 | 2.9 | 1.9 | .396 |
| 9 | 2.2 | ... | 2.4 | .. | 2.6 | .. | .503 |
| 10 | 2.0 | ... | 2.2 | .. | 2.3 | .. | .620 |
| 11 | 1.8 | ... | 2.0 | . | 2.1 | .. | .750 |
| 12 | 1.7 | ... | 1.8 | .. | 1.9 | .. | .896 |
| 13 | 1.5 | ... | 1.7 | .. | 1.8 | .. | 1.05 |
| 14 | 1.4 | ... | 1.5 | .. | 1.7 | .. | 1.22 |
| 15 | 1.3 | ... | 1.4 | .. | 1.5 | .. | 1.39 |




# STANDARD BEAMS

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I is Moment of Inertia
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V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 4" I

| Depth = d" | 4 | 4 | 4 | 4 |
|---|---|---|---|---|
| Wt. per foot | 7.7 | 8.5 | 9.5 | 10.5 |
| Area, sq. in. | 2.21 | 2.46 | 2.76 | 3.05 |
| b" | 2.66 | 2.72 | 2.80 | 2.87 |
| t | .190 | .253 | .326 | .400 |
| h | 3.208 | 3.208 | 3.208 | 3.208 |
| m | .396 | .396 | .396 | .396 |
| n | .190 | .190 | .190 | .190 |
| f | .29 | .29 | .29 | .29 |
| c | 2.717 | 2.717 | 2.717 | 2.717 |
| g | 1½ | 1½ | 1½ | 1½ |
| u | 5/16 | 5/16 | 5/16 | 5/16 |
| AXES X-X I | 6.0 | 6.3 | 6.7 | 7.1 |
| AXES X-X S | 3.0 | 3.15 | 3.35 | 3.55 |
| AXES X-X r | 1.64 | 1.60 | 1.56 | 1.52 |
| AXES Y-Y I | 0.77 | 0.83 | 0.91 | 1.0 |
| AXES Y-Y S | 0.58 | 0.61 | 0.65 | 0.70 |
| AXES Y-Y r | 0.59 | 0.58 | 0.58 | 0.57 |
| Coef. Str | 36000 | 37800 | 40200 | 42600 |
| Max. Mom." # | 54000 | 56700 | 60300 | 63900 |
| V | 9100 | 12100 | 15600 | 19200 |
| P. feet | 1.98 | 1.56 | 1.29 | 1.11 |
| R | 9100 | 12100 | 15600 | 19200 |
| W | 8550 | 11400 | 11900 | 11900 |
| Q. feet | 2.11 | 1.66 | 1.69 | 1.79 |
| w. lbs. | 5 | 5 | 5 | 5 |
| Rivet dia. | ½ | ½ | ½ | ½ |

Live Load Deflection must not exceed 1-360 of the Span.

Live Load Def. = $\frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load, laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 18.2 | 18.2 | 24.2 | 24.2 | 31.2 | 31.2 | 38.4 | 38.4 | |
| 2 | 18.0 | 18.0 | 18.9 | 18.9 | 20.1 | 20.1 | 21.3 | 21.3 | .019 |
| 3 | 12.0 | 12.0 | 12.6 | 12.6 | 13.4 | 13.4 | 14.2 | 14.2 | .042 |
| 4 | 9.0 | 8.6 | 9.5 | 9.1 | 10.1 | 10.0 | 10.7 | 10.4 | .074 |
| 5 | 7.2 | 6.4 | 7.6 | 6.8 | 8.0 | 7.2 | 8.5 | 7.7 | .116 |
| 6 | 6.0 | 4.9 | 6.3 | 5.2 | 6.7 | 5.6 | 7.1 | 6.0 | .168 |
| 7 | 5.1 | 3.8 | 5.4 | 4.1 | 5.7 | 4.4 | 6.1 | 4.7 | .228 |
| 8 | 4.5 | 3.0 | 4.7 | 3.2 | 5.0 | 3.5 | 5.3 | 3.8 | .298 |
| 9 | 4.0 | ... | 4.2 | 2.6 | 4.5 | 2.9 | 4.7 | 3.1 | .378 |
| 10 | 3.6 | .. | 3.8 | ... | 4.0 | ... | 4.3 | ... | .465 |
| 11 | 3.3 | ... | 3.4 | ... | 3.7 | ... | 3.9 | ... | .562 |
| 12 | 3.0 | ... | 3.1 | ... | 3.4 | ... | 3.6 | ... | .670 |
| 13 | 2.8 | ... | 2.9 | ... | 3.1 | ... | 3.3 | ... | .787 |
| 14 | 2.6 | ... | 2.7 | ... | 2.9 | ... | 3.0 | ... | .912 |
| 15 | 2.4 | ... | 2.5 | ... | 2.7 | ... | 2.8 | ... | 1.05 |

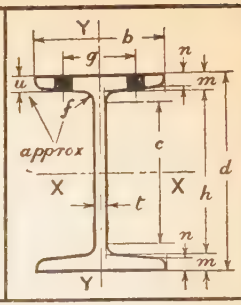
# 5" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



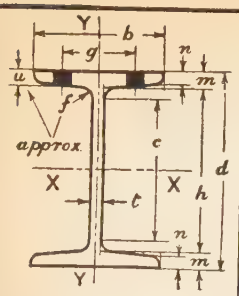

| | | | | |
|---|---|---|---|---|
| Depth = d" | | 5 | 5 | 5 |
| Wt. per foot | | 10.0 | 12.25 | 14.75 |
| Area, sq. in. | | 2.87 | 3.56 | 4.29 |
| b" | | 3.00 | 3.14 | 3.28 |
| t | | .210 | .347 | .494 |
| h | | 4.114 | 4.114 | 4.114 |
| m | | .443 | .443 | .443 |
| n | | .210 | .210 | .210 |
| f | | .31 | .31 | .31 |
| c | | 3.589 | 3.589 | 3.589 |
| g | | 1¾ | 1¾ | 1¾ |
| u | | ⅜ | ⅜ | ⅜ |
| AXES X-X | I | 12.1 | 13.5 | 15.0 |
| | S | 4.84 | 5.40 | 6.00 |
| | r | 2.05 | 1.95 | 1.87 |
| AXES Y-Y | I | 1.2 | 1.4 | 1.7 |
| | S | 0.82 | 0.91 | 1.0 |
| | r | 0.65 | 0.63 | 0.63 |
| Coef. Str. | | 58100 | 64800 | 72000 |
| Max. Mom." # | | 87120 | 97200 | 108000 |
| V | | 12600 | 20800 | 29600 |
| P. feet | | 2.30 | 1.56 | 1.22 |
| R | | 12600 | 20800 | 29600 |
| W | | 9450 | 11900 | 11900 |
| Q. feet | | 3.07 | 2.73 | 3.03 |
| w. lbs. | | 6 | 6 | 6 |
| Rivet dia. | | ½ | ½ | ½ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 1 | 25.2 | 25.2 | 41.6 | 41.6 | 59.2 | 59.2 | |
| 2 | 25.2 | 25.2 | 32.4 | 32.4 | 36.0 | 36.0 | |
| 3 | 19.4 | 19.4 | 21.6 | 21.6 | 24.0 | 24.0 | .033 |
| 4 | 14.5 | 14.3 | 16.2 | 16.1 | 18.0 | 18.0 | .059 |
| 5 | 11.6 | 10.7 | 13.0 | 12.2 | 14.4 | 13.7 | .093 |
| 6 | 9.7 | 8.4 | 10.8 | 9.5 | 12.0 | 10.8 | .134 |
| 7 | 8.3 | 6.6 | 9.3 | 7.6 | 10.3 | 8.6 | .182 |
| 8 | 7.3 | 5.4 | 8.1 | 6.1 | 9.0 | 7.0 | .238 |
| 9 | 6.5 | 4.4 | 7.2 | 5.0 | 8.0 | 5.8 | .302 |
| 10 | 5.8 | ... | 6.5 | 4.2 | 7.2 | 4.8 | .372 |
| 11 | 5.3 | ... | 5.9 | ... | 6.5 | ... | .450 |
| 12 | 4.8 | ... | 5.4 | ... | 6.0 | ... | .537 |
| 13 | 4.5 | ... | 5.0 | ... | 5.5 | ... | .630 |
| 14 | 4.2 | ... | 4.6 | ... | 5.1 | ... | .730 |
| 15 | 3.9 | ... | 4.3 | ... | 4.8 | ... | .838 |
| 16 | 3.6 | ... | 4.1 | ... | 4.5 | ... | .955 |
| 17 | 3.4 | ... | 3.8 | ... | 4.2 | ... | 1.08 |
| 18 | 3.2 | ... | 3.6 | ... | 4.0 | ... | 1.20 |
| 19 | 3.1 | ... | 3.4 | ... | 3.8 | ... | 1.34 |
| 20 | 2.9 | ... | 3.2 | ... | 3.6 | ... | 1.49 |




# STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 6" I

| Depth = d" | | 6 | 6 | 6 |
|---|---|---|---|---|
| Wt. per foot | | 12.5 | 14.75 | 17.25 |
| Area, sq. in. | | 3.61 | 4.29 | 5.02 |
| b" | | 3.33 | 3.44 | 3.57 |
| t | | .230 | .343 | .465 |
| h | | 5.024 | 5.024 | 5.024 |
| m | | .488 | .488 | .488 |
| n | | .230 | .230 | .230 |
| f | | .33 | .33 | .33 |
| c | | 4.465 | 4.465 | 4.465 |
| g | | 2 | 2 | 2 |
| u | | ⅜ | ⅜ | ⅜ |
| AXES X-X | I | 21.8 | 23.8 | 26.0 |
| | S | 7.27 | 7.93 | 8.67 |
| | r | 2.46 | 2.36 | 2.28 |
| AXES Y-Y | I | 1.8 | 2.1 | 2.3 |
| | S | 1.1 | 1.2 | 1.3 |
| | r | .72 | .69 | .68 |
| Coef. Str | | 87200 | 95200 | 104000 |
| Max. Mom." ⅛ | | 130800 | 142800 | 156000 |
| V | | 16600 | 24700 | 34500 |
| P. feet | | 2.63 | 1.93 | 1.51 |
| R | | 16600 | 24700 | 34500 |
| W | | 10350 | 11900 | 11900 |
| Q. feet | | 4.21 | 4.00 | 4.37 |
| w. lbs. | | 6 | 6 | 6 |
| Rivet dia | | ⅝ | ⅝ | ⅝ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 2 | 33.2 | 33.2 | 47.6 | 47.6 | 52.0 | 52.0 | |
| 3 | 29.1 | 29.1 | 31.7 | 31.7 | 34.7 | 34.7 | .028 |
| 4 | 21.8 | 21.8 | 23.8 | 23.8 | 26.0 | 26.0 | .050 |
| 5 | 17.4 | 16.6 | 19.0 | 18.3 | 20.8 | 20.2 | .078 |
| 6 | 14.5 | 13.1 | 15.9 | 14.5 | 17.3 | 16.0 | .112 |
| 7 | 12.5 | 10.5 | 13.6 | 11.6 | 14.9 | 13.0 | .152 |
| 8 | 10.9 | 8.5 | 11.9 | 9.5 | 13.0 | 10.6 | .198 |
| 9 | 9.7 | 7.1 | 10.6 | 7.9 | 11.6 | 8.9 | .252 |
| 10 | 8.7 | 5.9 | 9.5 | 6.6 | 10.4 | 7.4 | .310 |
| 11 | 7.9 | 5.0 | 8.7 | 5.6 | 9.5 | 6.3 | .375 |
| 12 | 7.3 | ... | 7.9 | ... | 8.7 | ... | .447 |
| 13 | 6.7 | ... | 7.3 | ... | 8.0 | ... | .525 |
| 14 | 6.2 | ... | 6.8 | ... | 7.4 | ... | .608 |
| 15 | 5.8 | ... | 6.3 | ... | 6.9 | ... | .698 |
| 16 | 5.5 | ... | 6.0 | ... | 6.5 | ... | .795 |
| 17 | 5.1 | ... | 5.6 | ... | 6.1 | ... | .898 |
| 18 | 4.8 | ... | 5.3 | ... | 5.8 | ... | 1.01 |
| 19 | 4.6 | ... | 5.0 | ... | 5.5 | ... | 1.12 |
| 20 | 4.4 | ... | 4.8 | ... | 5.2 | ... | 1.24 |
| 21 | 4.2 | ... | 4.5 | ... | 5.0 | ... | 1.37 |
| 22 | 4.0 | ... | 4.3 | ... | 4.7 | ... | 1.51 |
| 23 | 3.8 | ... | 4.1 | ... | 4.5 | ... | 1.64 |
| 24 | 3.6 | ... | 4.0 | ... | 4.3 | ... | 1.79 |
| 25 | 3.5 | ... | 3.8 | ... | 4.2 | ... | 1.94 |

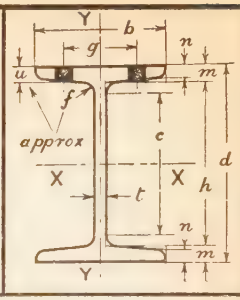
# 7" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



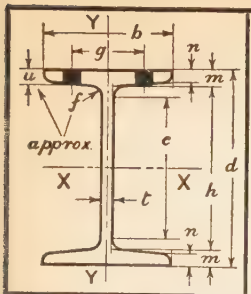

| | | | | |
|---|---|---|---|---|
| Depth = d" | | 7 | 7 | 7 |
| Wt. per foot | | **15.3** | 17.5 | 20.0 |
| Area, sq. in. | | 4.43 | 5.09 | 5.83 |
| b" | | 3.66 | 3.76 | 3.86 |
| t | | .250 | .345 | .450 |
| h | | 5.936 | 5.936 | 5.936 |
| m | | .534 | .534 | .534 |
| n | | .250 | .250 | .250 |
| f | | .35 | .35 | .35 |
| c | | 5.339 | 5.339 | 5.339 |
| g | | 2¼ | 2¼ | 2¼ |
| u | | ⅜ | ⅜ | ⅜ |
| AXES X-X | I | 36.2 | 38.9 | 41.9 |
| | S | 10.34 | 11.11 | 11.97 |
| | r | 2.86 | 2.77 | 2.68 |
| AXES Y-Y | I | 2.7 | 2.9 | 3.1 |
| | S | 1.5 | 1.6 | 1.6 |
| | r | 0.78 | 0.76 | 0.74 |
| Coef. Str. | | 124100 | 133400 | 143700 |
| Max. Mom." # | | 186200 | 200100 | 215500 |
| V | | 21000 | 29000 | 37800 |
| P. feet | | 2.95 | 2.30 | 1.90 |
| R | | 19700 | 27200 | 35400 |
| W | | 11250 | 11900 | 11900 |
| Q. feet | | 5.52 | 5.60 | 6.04 |
| w. lbs. | | 6 | 6 | 6 |
| Rivet dia. | | ⅝ | ⅝ | ⅝ |

Live Load Deflection must not exceed 1-360 of the Span.

Live Load Def. = $\frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 2 | 42.0 | 42.0 | 58.0 | 58.0 | 71.9 | 71.9 | |
| 3 | 41.4 | 41.4 | 44.5 | 44.5 | 47.9 | 47.9 | .024 |
| 4 | 31.0 | 31.0 | 33.4 | 33.4 | 36.0 | 36.0 | .043 |
| 5 | 24.8 | 24.3 | 26.7 | 26.3 | 28.7 | 28.5 | .067 |
| 6 | 20.7 | 19.3 | 22.2 | 20.9 | 24.0 | 22.7 | .096 |
| 7 | 17.7 | 15.6 | 19.1 | 17.0 | 20.5 | 18.4 | .130 |
| 8 | 15.5 | 12.8 | 16.7 | 14.0 | 18.0 | 15.3 | .170 |
| 9 | 13.8 | 10.7 | 14.8 | 11.6 | 16.0 | 12.7 | .216 |
| 10 | 12.4 | 9.0 | 13.3 | 9.8 | 14.4 | 10.8 | .266 |
| 11 | 11.3 | 7.6 | 12.1 | 8.3 | 13.1 | 9.2 | .321 |
| 12 | 10.3 | 6.4 | 11.1 | 7.1 | 12.0 | 7.9 | .383 |
| 13 | 9.5 | ... | 10.3 | ... | 11.1 | ... | .450 |
| 14 | 8.9 | ... | 9.5 | ... | 10.3 | ... | .521 |
| 15 | 8.3 | ... | 8.9 | ... | 9.6 | ... | .599 |
| 16 | 7.7 | ... | 8.3 | ... | 9.0 | ... | .681 |
| 17 | 7.3 | ... | 7.8 | ... | 8.5 | ... | .770 |
| 18 | 6.9 | ... | 7.4 | ... | 8.0 | ... | .861 |
| 19 | 6.5 | ... | 7.0 | ... | 7.6 | ... | .960 |
| 20 | 6.2 | ... | 6.7 | ... | 7.2 | ... | 1.06 |
| 21 | 5.9 | ... | 6.4 | ... | 6.8 | ... | 1.17 |
| 22 | 5.6 | ... | 6.1 | ... | 6.5 | ... | 1.29 |
| 23 | 5.4 | ... | 5.8 | ... | 6.2 | ... | 1.41 |
| 24 | 5.2 | ... | 5.6 | ... | 6.0 | ... | 1.53 |
| 25 | 5.0 | ... | 5.3 | ... | 5.7 | ... | 1.66 |




# STANDARD BEAMS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 8" I

| | | | | | |
|---|---|---|---|---|---|
| Depth = d" | | 8 | 8 | 8 | 8 |
| Wt. per foot | | 18.4 | 20.5 | 23.0 | 25.5 |
| Area, sq. in. | | 5.34 | 5.97 | 6.71 | 7.43 |
| b" | | 4.00 | 4.08 | 4.17 | 4.26 |
| t | | .270 | .349 | .441 | .532 |
| h | | 6.838 | 6.838 | 6.838 | 6.838 |
| m | | .581 | .581 | .581 | .581 |
| n | | .270 | .270 | .270 | .270 |
| f | | .37 | .37 | .37 | .37 |
| c | | 6.211 | 6.211 | 6.211 | 6.211 |
| g | | 2¼ | 2¼ | 2¼ | 2¼ |
| u | | 7/16 | 7/16 | 7/16 | ½ |
| AXES X-X | I | 56.9 | 60.2 | 64.2 | 68.1 |
| | S | 14.22 | 15.05 | 16.05 | 17.02 |
| | r | 3.26 | 3.18 | 3.09 | 3.03 |
| AXES Y-Y | I | 3.8 | 4.0 | 4.4 | 4.7 |
| | S | 1.9 | 2.0 | 2.1 | 2.2 |
| | r | 0.84 | 0.82 | 0.81 | 0.80 |
| Coef. Str. | | 170700 | 180600 | 192600 | 204300 |
| Max. Mom." | | 256100 | 270900 | 288900 | 306450 |
| V | | 25900 | 33500 | 42300 | 51100 |
| P. feet | | 3.30 | 2.70 | 2.28 | 2.00 |
| R | | 22300 | 28800 | 36400 | 43900 |
| W | | 23800 | 23800 | 23800 | 23800 |
| Q. feet | | 3.59 | 3.79 | 4.05 | 4.29 |
| w. lbs. | | 13 | 13 | 13 | 13 |
| Rivet dia. | | ¾ | ¾ | ¾ | ¾ |

Live Load Deflection must not exceed 1-360 of the Span.

Live Load Def. = $\frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 51.8 | 51.8 | 67.0 | 67.0 | 84.6 | 84.6 | | | |
| 3 | 51.8 | 51.8 | 60.2 | 60.2 | 64.2 | 64.2 | 68.1 | 68.1 | |
| 4 | 42.7 | 42.7 | 45.2 | 45.2 | 48.2 | 48.2 | 51.1 | 51.1 | .037 |
| 5 | 34.1 | 34.1 | 36.1 | 36.1 | 38.5 | 38.5 | 40.9 | 40.9 | .058 |
| 6 | 28.5 | 27.2 | 30.1 | 28.9 | 32.1 | 31.0 | 34.1 | 33.1 | .084 |
| 7 | 24.4 | 22.2 | 25.8 | 23.7 | 27.5 | 25.4 | 29.2 | 27.2 | .114 |
| 8 | 21.3 | 18.4 | 22.6 | 19.7 | 24.1 | 21.2 | 25.5 | 22.6 | .149 |
| 9 | 19.0 | 15.5 | 20.1 | 16.5 | 21.4 | 17.8 | 22.7 | 19.1 | .189 |
| 10 | 17.1 | 13.1 | 18.1 | 14.0 | 19.3 | 15.2 | 20.4 | 16.2 | .233 |
| 11 | 15.5 | 11.1 | 16.4 | 11.9 | 17.5 | 13.0 | 18.6 | 14.0 | .281 |
| 12 | 14.2 | 9.6 | 15.1 | 10.3 | 16.1 | 11.2 | 17.0 | 12.0 | .335 |
| 13 | 13.1 | 8.3 | 13.9 | 8.9 | 14.8 | 9.7 | 15.7 | 10.4 | .394 |
| 14 | 12.2 | ... | 12.9 | ... | 13.8 | ... | 14.6 | 9.1 | .456 |
| 15 | 11.4 | ... | 12.0 | ... | 12.8 | ... | 13.6 | ... | .524 |
| 16 | 10.7 | ... | 11.3 | ... | 12.0 | ... | 12.8 | ... | .596 |
| 17 | 10.0 | ... | 10.6 | .. | 11.3 | ... | 12.0 | ... | .674 |
| 18 | 9.5 | ... | 10.0 | ... | 10.7 | ... | 11.4 | ... | .754 |
| 19 | 9.0 | ... | 9.5 | ... | 10.1 | ... | 10.8 | ... | .840 |
| 20 | 8.5 | ... | 9.0 | ... | 9.6 | ... | 10.2 | ... | .931 |
| 21 | 8.1 | ... | 8.6 | ... | 9.2 | ... | 9.7 | ... | 1.03 |
| 22 | 7.8 | ... | 8.2 | ... | 8.8 | ... | 9.3 | ... | 1.13 |
| 23 | 7.4 | ... | 7.9 | ... | 8.4 | ... | 8.9 | ... | 1.23 |
| 24 | 7.1 | ... | 7.5 | ... | 8.0 | ... | 8.5 | ... | 1.34 |
| 25 | 6.8 | ... | 7.2 | ... | 7.7 | ... | 8.2 | ... | 1.46 |

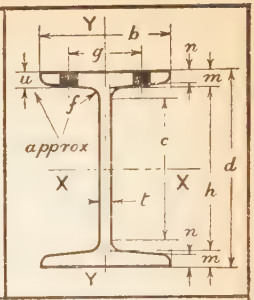
# 9" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown



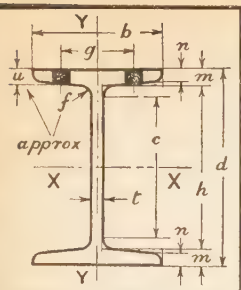

| Depth = d" | | | 9 | 9 | 9 | 9 |
|---|---|---|---|---|---|---|
| Wt. per foot | | | **21.8** | 25.0 | 30.0 | 35.0 |
| Area, sq. in. | | | 6.32 | 7.28 | 8.76 | 10.22 |
| b" | | | 4.33 | 4.44 | 4.60 | 4.76 |
| t | | | .290 | .397 | .561 | .724 |
| h | | | 7.746 | 7.746 | 7.746 | 7.746 |
| m | | | .627 | .627 | .627 | .627 |
| n | | | .290 | .290 | .290 | .290 |
| f | | | .39 | .39 | .39 | .39 |
| c | | | 7.085 | 7.085 | 7.085 | 7.085 |
| g | | | 2½ | 2½ | 2½ | 2½ |
| u | | | ½ | ½ | ½ | ½ |
| AXES | X-X | I | 84.9 | 91.4 | 101.4 | 111.3 |
| | | S | 18.87 | 20.31 | 22.53 | 24.73 |
| | | r | 3.67 | 3.54 | 3.40 | 3.30 |
| | Y-Y | I | 5.2 | 5.6 | 6.4 | 7.3 |
| | | S | 2.4 | 2.5 | 2.8 | 3.0 |
| | | r | 0.90 | 0.88 | 0.85 | 0.84 |
| Coef. Str | | | 226400 | 243700 | 270400 | 296800 |
| Max. Mom." # | | | 339600 | 365600 | 405600 | 445200 |
| V | | | 31300 | 42900 | 60600 | 78200 |
| P, feet | | | 3.62 | 2.84 | 2.23 | 1.90 |
| R | | | 25000 | 31200 | 48400 | 62400 |
| W | | | 23800 | 23800 | 23800 | 23800 |
| Q, feet | | | 4.76 | 5.12 | 5.68 | 6.24 |
| w, lbs. | | | 13 | 13 | 13 | 13 |
| Rivet dia. | | | ¾ | ¾ | ¾ | ¾ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 62.6 | 62.6 | 81.2 | 81.2 | 90.1 | 90.1 | 98.9 | 98.9 | |
| 4 | 56.6 | 56.6 | 60.9 | 60.9 | 67.6 | 67.6 | 74.2 | 74.2 | .033 |
| 5 | 45.3 | 45.3 | 48.7 | 48.7 | 54.1 | 54.1 | 59.1 | 59.4 | .052 |
| 6 | 37.7 | 36.8 | 40.6 | 39.9 | 45.1 | 44.7 | 49.5 | 49.4 | .074 |
| 7 | 32.3 | 30.2 | 34.8 | 32.8 | 38.6 | 36.7 | 42.4 | 40.7 | .101 |
| 8 | 28.3 | 25.2 | 30.5 | 27.5 | 33.8 | 30.8 | 37.1 | 34.2 | .132 |
| 9 | 25.2 | 21.4 | 27.1 | 23.2 | 30.0 | 26.1 | 33.0 | 29.2 | .168 |
| 10 | 22.6 | 18.1 | 24.4 | 19.9 | 27.0 | 22.4 | 29.7 | 25.0 | .207 |
| 11 | 20.6 | 15.6 | 22.2 | 17.1 | 24.6 | 19.3 | 27.0 | 21.7 | .250 |
| 12 | 18.9 | 13.5 | 20.3 | 14.8 | 22.5 | 16.8 | 24.7 | 18.8 | .298 |
| 13 | 17.4 | 11.7 | 18.7 | 12.9 | 20.8 | 14.7 | 22.8 | 16.5 | .350 |
| 14 | 16.2 | ... | 17.4 | 11.3 | 19.3 | 12.9 | 21.2 | 14.5 | .406 |
| 15 | 15.1 | ... | 16.2 | ... | 18.0 | 11.3 | 19.8 | 12.8 | .466 |
| 16 | 14.2 | ... | 15.2 | ... | 16.9 | ... | 18.6 | ... | .530 |
| 17 | 13.3 | ... | 14.3 | ... | 15.9 | ... | 17.5 | ... | .599 |
| 18 | 12.6 | ... | 13.5 | ... | 15.0 | .. | 16.5 | ... | .670 |
| 19 | 11.9 | ... | 12.8 | ... | 14.2 | ... | 15.6 | ... | .747 |
| 20 | 11.3 | ... | 12.2 | ... | 13.5 | ... | 14.8 | ... | .828 |
| 21 | 10.8 | ... | 11.6 | ... | 12.9 | ... | 14.1 | ... | .912 |
| 22 | 10.3 | ... | 11.1 | ... | 12.3 | ... | 13.5 | ... | 1.00 |
| 23 | 9.8 | ... | 10.6 | ... | 11.8 | ... | 12.9 | ... | 1.10 |
| 24 | 9.4 | ... | 10.2 | ... | 11.3 | ... | 12.4 | ... | 1.19 |
| 25 | 9.1 | ... | 9.7 | ... | 10.8 | ... | 11.9 | ... | 1.29 |




# STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 10" I

| | | | | | |
|---|---|---|---|---|---|
| Depth = d″ | | 10 | 10 | 10 | 10 |
| Wt. per foot | | **25.4** | 30.0 | 35.0 | 40.0 |
| Area, sq. in. | | 7.38 | 8.75 | 10.22 | 11.69 |
| b″ | | 4.66 | 4.80 | 4.94 | 5.09 |
| t | | .310 | .447 | .594 | .741 |
| h | | 8.654 | 8.654 | 8.654 | 8.654 |
| m | | .673 | .673 | .673 | .673 |
| n | | .310 | .310 | .310 | .310 |
| f | | .41 | .41 | .41 | .41 |
| c | | 7.959 | 7.959 | 7.959 | 7.959 |
| g | | 2¾ | 2¾ | 2¾ | 2¾ |
| u | | ½ | ½ | ½ | ½ |
| AXES X-X | I | 122.1 | 133.5 | 145.8 | 158.0 |
| | S | 24.42 | 26.70 | 29.16 | 31.60 |
| | r | 4.07 | 3.91 | 3.78 | 3.68 |
| AXES Y-Y | I | 6.9 | 7.6 | 8.5 | 9.4 |
| | S | 3.0 | 3.2 | 3.4 | 3.7 |
| | r | 0.97 | 0.93 | 0.91 | 0.90 |
| Coef. Str. | | 293000 | 320400 | 349900 | 379200 |
| Max. Mon.″ # | | 439600 | 480600 | 524900 | 568800 |
| V | | 37200 | 53600 | 71300 | 88900 |
| P. feet | | 3.94 | 2.99 | 2.45 | 2.13 |
| R | | 27900 | 40200 | 53500 | 65700 |
| W | | 23800 | 23800 | 23800 | 23800 |
| Q. feet | | 6.16 | 6.73 | 7.35 | 7.97 |
| w. lbs. | | 13 | 13 | 13 | 13 |
| Rivet dia. | | ¾ | ¾ | ¾ | ¾ |

Live Load Deflection must not exceed 1-360 of the Span.

Total Def. × Live Load / Tabular Load = Live Load Def.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 74.4 | 74.4 | 106 | 106 | 116 | 116 | 126 | 126 | |
| 4 | 73.3 | 73.3 | 80.1 | 80.1 | 87.5 | 87.5 | 94.8 | 94.8 | .030 |
| 5 | 58.6 | 58.6 | 64.1 | 64.1 | 70.0 | 70.0 | 75.8 | 75.8 | .047 |
| 6 | 48.8 | 48.4 | 53.4 | 53.4 | 58.3 | 58.3 | 63.2 | 63.2 | .067 |
| 7 | 41.9 | 40.0 | 45.8 | 44.1 | 50.0 | 48.5 | 54.2 | 53.0 | .091 |
| 8 | 36.6 | 33.6 | 40.1 | 37.1 | 43.7 | 40.9 | 47.4 | 44.7 | .119 |
| 9 | 32.6 | 28.6 | 35.6 | 31.6 | 38.9 | 34.9 | 42.1 | 38.2 | .151 |
| 10 | 29.3 | 24.5 | 32.0 | 27.1 | 35.0 | 30.0 | 37.9 | 32.9 | .186 |
| 11 | 26.6 | 21.1 | 29.1 | 23.5 | 31.8 | 26.0 | 34.5 | 28.7 | .225 |
| 12 | 24.4 | 18.4 | 26.7 | 20.5 | 29.2 | 22.8 | 31.6 | 25.1 | .268 |
| 13 | 22.5 | 16.6 | 24.6 | 17.9 | 26.9 | 19.9 | 29.2 | 22.1 | .315 |
| 14 | 20.9 | 14.1 | 22.9 | 15.8 | 25.0 | 17.6 | 27.1 | 19.5 | .365 |
| 15 | 19.5 | 12.4 | 21.4 | 14.0 | 23.3 | 15.6 | 25.3 | 17.3 | .419 |
| 16 | 18.3 | ... | 20.0 | 12.3 | 21.9 | 13.9 | 23.7 | 15.4 | .477 |
| 17 | 17.2 | ... | 18.8 | ... | 20.6 | ... | 22.3 | ... | .539 |
| 18 | 16.3 | ... | 17.8 | ... | 19.4 | ... | 21.1 | ... | .603 |
| 19 | 15.4 | ... | 16.9 | ... | 18.4 | ... | 20.0 | ... | .672 |
| 20 | 14.7 | ... | 16.0 | ... | 17.5 | ... | 19.0 | ... | .745 |
| 21 | 14.0 | ... | 15.3 | ... | 16.7 | ... | 18.1 | ... | .821 |
| 22 | 13.3 | ... | 14.6 | ... | 15.9 | ... | 17.2 | ... | .901 |
| 23 | 12.7 | ... | 13.9 | ... | 15.2 | ... | 16.5 | ... | .986 |
| 24 | 12.2 | ... | 13.4 | ... | 14.6 | ... | 15.8 | ... | 1.07 |
| 25 | 11.7 | ... | 12.8 | ... | 14.0 | ... | 15.2 | ... | 1.16 |

# 12" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

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W is Maximum Load on one Standard Connection
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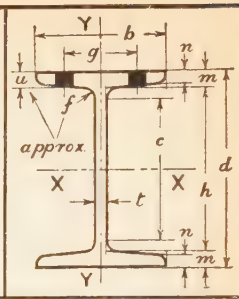
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflection 80% of those shown




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d" | | 12 | 12 | 12 | 12 | 12 | 12 |
| Wt. per foot | | **31.8** | 35.0 | **40.8** | 45.0 | 50.0 | 55.0 |
| Area, sq. in. | | 9.26 | 10.20 | 11.84 | 13.10 | 14.57 | 16.04 |
| b" | | 5.00 | 5.08 | 5.25 | 5.36 | 5.48 | 5.60 |
| t | | .350 | .428 | .460 | .565 | .687 | .810 |
| h | | 10.524 | 10.524 | 10.282 | 10.282 | 10.282 | 10.282 |
| m | | .738 | .738 | .859 | .859 | .859 | .859 |
| n | | .350 | .350 | .460 | .460 | .460 | .460 |
| f | | .45 | .45 | .56 | .56 | .56 | .56 |
| c | | 9.762 | 9.762 | 9.333 | 9.333 | 9.333 | 9.333 |
| g | | 3" | 3" | 3" | 3" | 3½ | 3½ |
| u | | 9/16 | 9/16 | ¾ | ¾ | ¾ | ¾ |
| AXES X-X | I | 215.8 | 227.0 | 268.9 | 284.1 | 301.6 | 319.3 |
| | S | 35.97 | 37.83 | 44.82 | 47.35 | 50.27 | 53.22 |
| | r | 4.83 | 4.72 | 4.77 | 4.66 | 4.55 | 4.46 |
| AXES Y-Y | I | 9.5 | 10.0 | 13.8 | 14.8 | 16.0 | 17.3 |
| | S | 3.8 | 3.9 | 5.3 | 5.5 | 5.8 | 6.2 |
| | r | 1.01 | 0.99 | 1.08 | 1.06 | 1.05 | 1.04 |
| Coef. Str. | | 431600 | 454000 | 537800 | 568200 | 603200 | 638600 |
| Max. Mom." # | | 647400 | 681000 | 806700 | 852300 | 904800 | 957900 |
| V | | 50400 | 61600 | 66200 | 81400 | 98900 | 116600 |
| P, feet | | 4.28 | 3.68 | 4.06 | 3.49 | 3.05 | 2.74 |
| R | | 34100 | 41700 | 44900 | 55100 | 67000 | 79000 |
| W | | 23860 | 23860 | 23860 | 23860 | 23860 | 23860 |
| Q, feet | | 9.04 | 9.51 | 11.27 | 11.91 | 12.64 | 13.38 |
| w, lbs. | | 13 | 13 | 13 | 13 | 13 | 13 |
| Rivet dia. | | ¾ | ¾ | ¾ | ¾ | ¾ | ¾ |

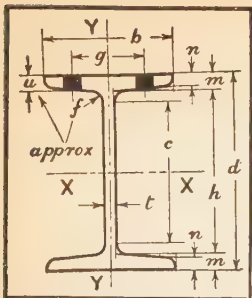
Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Total Deflection in inches for Maximum Load; laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 101 | 101 | 123 | 123 | 132 | 132 | 163 | 163 | 198 | 198 | 213 | 213 | |
| 4 | 101 | 101 | 114 | 114 | 132 | 132 | 142 | 142 | 151 | 151 | 160 | 160 | |
| 5 | 86 | 86 | 91 | 91 | 108 | 108 | 114 | 114 | 121 | 121 | 128 | 128 | .039 |
| 6 | 72 | 72 | 76 | 76 | 90 | 90 | 95 | 95 | 101 | 101 | 106 | 106 | .056 |
| 7 | 62 | 60 | 65 | 64 | 77 | 76 | 81 | 80 | 86 | 85 | 91 | 91 | .076 |
| 8 | 54 | 51 | 57 | 54 | 67 | 64 | 71 | 68 | 75 | 72 | 80 | 78 | .099 |
| 9 | 48 | 43 | 50 | 45 | 60 | 55 | 63 | 58 | 67 | 62 | 71 | 67 | .126 |
| 10 | 43 | 37 | 45 | 39 | 54 | 48 | 57 | 51 | 60 | 54 | 64 | 58 | .155 |
| 11 | 39 | 32 | 41 | 34 | 49 | 41 | 52 | 44 | 55 | 47 | 58 | 50 | .188 |
| 12 | 36 | 28 | 38 | 30 | 45 | 36 | 47 | 38 | 50 | 41 | 53 | 44 | .223 |
| 13 | 33 | 25 | 35 | 26 | 41 | 32 | 44 | 34 | 46 | 36 | 49 | 39 | .263 |
| 14 | 31 | 22 | 32 | 23 | 38 | 28 | 41 | 31 | 43 | 33 | 46 | 35 | .304 |
| 15 | 29 | 20 | 30 | 21 | 36 | 25 | 38 | 27 | 40 | 29 | 43 | 32 | .341 |
| 16 | 27 | 17 | 28 | 18 | 34 | 23 | 36 | 24 | 38 | 26 | 40 | 28 | .398 |
| 17 | 25 | ... | 27 | . | 32 | 20 | 33 | 21 | 35 | 23 | 38 | 25 | .449 |
| 18 | 24 | ... | 25 | . | 30 | .. | 32 | . | 34 | 21 | 35 | 22 | .503 |
| 19 | 23 | ... | 24 | . | 28 | .. | 30 | .. | 32 | ... | 34 | ... | .560 |
| 20 | 22 | ... | 23 | . . | 27 | .. | 28 | .. | 30 | ... | 32 | ... | .621 |
| 21 | 21 | .. | 22 | | 26 | | 27 | . | 29 | ... | 30 | ... | .684 |
| 22 | 20 | .. | 21 | | 24 | . | 26 | | 27 | ... | 29 | ... | .751 |
| 23 | 19 | .. | 20 | . | 23 | . | 25 | | 26 | .. | 28 | ... | .822 |
| 24 | 18 | .. | 19 | .. | 22 | .. | 24 | .. | 25 | ... | 27 | ... | .894 |
| **25** | **17** | | **18** | | **21** | | **23** | | **24** | | **26** | | **.970** |

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W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 15" I

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d" | | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Wt. per foot | | 42.9 | 45.0 | 50.0 | 55.0 | 60.8 | 65.0 | 70.0 | 75.0 | | |
| Area, sq. in. | | 12.49 | 13.12 | 14.59 | 16.06 | 17.68 | 18.91 | 20.38 | 21.85 | | |
| b" | | 5.50 | 5.54 | 5.64 | 5.74 | 6.00 | 6.08 | 6.18 | 6.28 | | |
| t | | .410 | .452 | .550 | .648 | .590 | .672 | .770 | .868 | | |
| h | | 13.332 | 13.332 | 13.332 | 13.332 | 12.918 | 12.918 | 12.918 | 12.918 | | |
| m | | .834 | .834 | .834 | .834 | 1.041 | 1.041 | 1.041 | 1.041 | | |
| n | | .410 | .410 | .410 | .410 | .590 | .590 | .590 | .590 | | |
| f | | .51 | .51 | .51 | .51 | .69 | .69 | .69 | .69 | | |
| c | | 12.468 | 12.468 | 12.468 | 12.468 | 11.749 | 11.749 | 11.749 | 11.749 | | |
| g | | 3½ | 3½ | 3½ | 3½ | 3½ | 3½ | 3½ | 3½ | | |
| u | | ⅝ | ⅝ | ⅝ | ⅝ | ⅞ | ⅞ | ⅞ | ⅞ | | |
| AXES X-X | I | 441.8 | 453.6 | 481.1 | 508.7 | 609.0 | 632.1 | 659.6 | 687.2 | | |
| | S | 58.91 | 60.48 | 64.15 | 67.83 | 81.20 | 84.28 | 87.95 | 91.63 | | |
| | r | 5.95 | 5.88 | 5.74 | 5.63 | 5.87 | 5.78 | 5.69 | 5.61 | | |
| AXES Y-Y | I | 14.6 | 15.0 | 16.0 | 17.0 | 26.0 | 27.2 | 28.8 | 30.6 | | |
| | S | 5.3 | 5.4 | 5.7 | 5.9 | 8.7 | 8.9 | 9.3 | 9.8 | | |
| | r | 1.08 | 1.07 | 1.05 | 1.03 | 1.21 | 1.20 | 1.19 | 1.18 | | |
| Coef. Str. | | 706900 | 725800 | 769800 | 813900 | 974400 | 1011400 | 1055400 | 1099500 | | |
| Max. Mom." ″ | | 1060300 | 1088600 | 1154600 | 1220900 | 1461600 | 1517000 | 1583000 | 1649300 | | |
| V | | 73800 | 81400 | 99000 | 116600 | 106200 | 121000 | 138600 | 156200 | | |
| P. feet | | 4.79 | 4.46 | 3.89 | 3.49 | 4.59 | 4.18 | 3.81 | 3.52 | | |
| R | | 43800 | 49200 | 59800 | 70500 | 64200 | 73100 | 83700 | 94400 | | |
| W | | 36900 | 40700 | 47700 | 47700 | 47700 | 47700 | 47700 | 47700 | | |
| Q feet | | 9.58 | 8.92 | 8.07 | 8.53 | 10.21 | 10.60 | 11.06 | 11.53 | | |
| w. lbs. | | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | | |
| Rivet dia. | | ¾ | ¾ | ¾ | ¾ | ¾ | ¾ | ¾ | ¾ | | |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 148 | 148 | 163 | 163 | 192 | 192 | 204 | 204 | 212 | 212 | 242 | 242 | 264 | 264 | 275 | 275 | |
| 5 | 141 | 141 | 145 | 145 | 154 | 154 | 163 | 163 | 195 | 195 | 202 | 202 | 211 | 211 | 220 | 220 | .031 |
| 6 | 118 | 118 | 121 | 121 | 128 | 128 | 136 | 136 | 162 | 162 | 169 | 169 | 176 | 176 | 183 | 183 | .045 |
| 7 | 101 | 100 | 104 | 104 | 110 | 110 | 116 | 116 | 139 | 139 | 145 | 145 | 151 | 151 | 157 | 157 | .061 |
| 8 | 88 | 85 | 91 | 88 | 96 | 93 | 102 | 99 | 122 | 120 | 126 | 124 | 132 | 131 | 137 | 136 | .079 |
| 9 | 79 | 74 | 81 | 76 | 86 | 81 | 90 | 85 | 108 | 103 | 112 | 108 | 117 | 113 | 122 | 118 | .101 |
| 10 | 71 | 64 | 73 | 66 | 77 | 70 | 81 | 74 | 97 | 90 | 101 | 94 | 106 | 99 | 110 | 103 | .124 |
| 11 | 64 | 55 | 66 | 57 | 70 | 61 | 74 | 65 | 89 | 80 | 92 | 83 | 96 | 87 | 100 | 91 | .150 |
| 12 | 59 | 49 | 60 | 50 | 64 | 54 | 68 | 57 | 81 | 70 | 84 | 73 | 88 | 77 | 92 | 81 | .179 |
| 13 | 54 | 43 | 56 | 45 | 59 | 47 | 63 | 51 | 75 | 62 | 78 | 65 | 81 | 68 | 85 | 72 | .210 |
| 14 | 50 | 38 | 52 | 40 | 55 | 42 | 58 | 45 | 70 | 56 | 72 | 58 | 75 | 61 | 79 | 65 | .243 |
| 15 | 47 | 34 | 48 | 35 | 51 | 38 | 54 | 40 | 65 | 50 | 67 | 52 | 70 | 55 | 73 | 58 | .279 |
| 16 | 44 | 30 | 45 | 31 | 48 | 34 | 51 | 36 | 61 | 45 | 63 | 46 | 66 | 50 | 69 | 52 | .318 |
| 17 | 42 | 28 | 43 | 28 | 45 | 30 | 48 | 33 | 57 | 40 | 59 | 42 | 62 | 45 | 65 | 47 | .359 |
| 18 | 39 | 24 | 40 | 25 | 43 | 28 | 45 | 29 | 54 | 36 | 56 | 39 | 59 | 41 | 61 | 43 | .402 |
| 19 | 37 | ... | 38 | ... | 41 | ... | 43 | 27 | 51 | 33 | 53 | 35 | 56 | 37 | 58 | 39 | .448 |
| 20 | 35 | ... | 36 | ... | 38 | ... | 41 | ... | 49 | 30 | 51 | 32 | 53 | 34 | 55 | 35 | .497 |
| 21 | 34 | ... | 35 | ... | 37 | ... | 39 | ... | 46 | ... | 48 | ... | 50 | ... | 52 | ... | .547 |
| 22 | 32 | ... | 33 | ... | 35 | ... | 37 | ... | 44 | ... | 46 | ... | 48 | ... | 50 | ... | .601 |
| 23 | 31 | ... | 32 | ... | 33 | ... | 35 | ... | 42 | ... | 44 | ... | 46 | ... | 48 | ... | .651 |
| 24 | 29 | ... | 30 | ... | 32 | ... | 34 | ... | 41 | ... | 42 | ... | 44 | ... | 46 | ... | .715 |
| 25 | 28 | ... | 29 | ... | 31 | ... | 33 | ... | 39 | ... | 40 | ... | 42 | ... | 44 | ... | .776 |
| 26 | 27 | ... | 28 | ... | 30 | ... | 31 | ... | 37 | ... | 39 | ... | 41 | ... | 42 | ... | .839 |
| 27 | 26 | ... | 27 | ... | 29 | ... | 30 | ... | 36 | ... | 37 | ... | 39 | ... | 41 | ... | .905 |
| 28 | 25 | ... | 26 | ... | 27 | ... | 29 | ... | 35 | ... | 36 | ... | 38 | ... | 39 | ... | .973 |
| 29 | 24 | ... | 25 | ... | 27 | ... | 28 | ... | 34 | ... | 35 | ... | 36 | ... | 38 | ... | 1.040 |
| 30 | 24 | ... | 24 | ... | 26 | ... | 27 | ... | 32 | ... | 34 | ... | 35 | ... | 37 | ... | 1.120 |

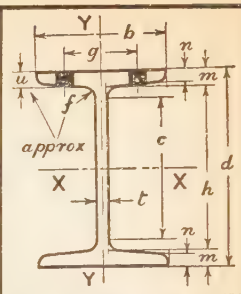
# 18" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

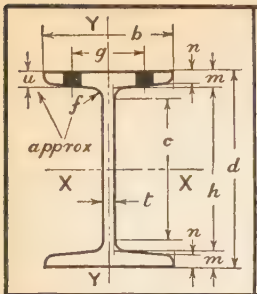



| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d" | | | 18 | | 18 | | 18 | | 18 | | 18 | | 18 | | 18 | | |
| Wt. per foot | | | 54.7 | | 60.0 | | 65.0 | | 70.0 | | 75.6 | | 80.0 | | 85.0 | | 90.0 |
| Area, sq. in. | | | 15.94 | | 17.50 | | 18.98 | | 20.46 | | 22.04 | | 23.34 | | 24.81 | | 26.29 |
| b" | | | 6.00 | | 6.09 | | 6.17 | | 6.25 | | 7.00 | | 7.07 | | 7.15 | | 7.24 |
| t | | | .460 | | .547 | | .629 | | .711 | | .560 | | .632 | | .714 | | .796 |
| h | | | 16.156 | | 16.156 | | 16.156 | | 16.156 | | 15.610 | | 15.610 | | 15.610 | | 15.610 |
| m | | | .922 | | .922 | | .922 | | .922 | | 1.195 | | 1.195 | | 1.195 | | 1.195 |
| n | | | .460 | | .460 | | .460 | | .460 | | .659 | | .659 | | .659 | | .659 |
| f | | | .56 | | .56 | | .56 | | .56 | | .66 | | .66 | | .66 | | .66 |
| c | | | 15.207 | | 15.207 | | 15.207 | | 15.207 | | 14.492 | | 14.492 | | 14.492 | | 14.492 |
| g | | | 3¾ | | 3¾ | | 3¾ | | 3¾ | | 4" | | 4" | | 4" | | 4" |
| u | | | ¾ | | ¾ | | ¾ | | ¾ | | 1" | | 1" | | 1" | | 1" |
| AXES | X-X | I | 795.5 | | 837.8 | | 877.7 | | 917.5 | | 1141.8 | | 1176.8 | | 1216.6 | | 1256.5 |
| | | S | 88.39 | | 93.09 | | 97.53 | | 101.94 | | 126.87 | | 130.76 | | 135.18 | | 139.61 |
| | | r | 7.07 | | 6.92 | | 6.80 | | 6.70 | | 7.20 | | 7.10 | | 7.00 | | 6.91 |
| | Y-Y | I | 21.2 | | 22.3 | | 23.4 | | 24.5 | | 46.3 | | 47.9 | | 49.8 | | 51.9 |
| | | S | 7.1 | | 7.3 | | 7.6 | | 7.8 | | 13.2 | | 13.6 | | 14.0 | | 14.3 |
| | | r | 1.15 | | 1.13 | | 1.11 | | 1.09 | | 1.45 | | 1.43 | | 1.42 | | 1.40 |
| Coef. Str. | | | 1060700 | | 1117100 | | 1170300 | | 1223300 | | 1522400 | | 1569100 | | 1622100 | | 1675300 |
| Max.Mom." # | | | 1591000 | | 1675600 | | 1755400 | | 1835000 | | 2283600 | | 2353600 | | 2433200 | | 2513000 |
| V | | | 99400 | | 118200 | | 135900 | | 153600 | | 121000 | | 136500 | | 154200 | | 171900 |
| P. feet | | | 5.34 | | 4.73 | | 4.31 | | 3.98 | | 6.29 | | 5.75 | | 5.26 | | 4.88 |
| R | | | 52800 | | 65600 | | 75500 | | 85300 | | 67200 | | 75800 | | 85700 | | 95500 |
| W | | | 41400 | | 47700 | | 47700 | | 47700 | | 47700 | | 47700 | | 47700 | | 47700 |
| Q. feet | | | 12.81 | | 11.71 | | 12.27 | | 12.82 | | 15.96 | | 16.45 | | 17.00 | | 17.56 |
| w. lbs. | | | 19 | | 19 | | 19 | | 19 | | 19 | | 19 | | 19 | | 19 |
| Rivet dia. | | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ |

Live Load Deflection must not exceed 1-360 of the Span.

Total Def. × Live Load / Tabular Load = Live Load Def.

| Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. | Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 177 | 177 | 186 | 186 | 195 | 195 | 204 | 204 | 242 | 242 | 262 | 262 | 270 | 270 | 279 | 279 | .037 |
| | 7 | 152 | 152 | 160 | 160 | 167 | 167 | 175 | 175 | 218 | 218 | 224 | 224 | 232 | 232 | 239 | 239 | .051 |
| | 8 | 133 | 131 | 140 | 138 | 146 | 145 | 153 | 152 | 190 | 190 | 196 | 196 | 203 | 203 | 209 | 209 | .066 |
| | 9 | 118 | 113 | 124 | 119 | 130 | 125 | 136 | 132 | 169 | 168 | 174 | 173 | 180 | 180 | 186 | 186 | .084 |
| | 10 | 106 | 98 | 112 | 104 | 117 | 109 | 122 | 114 | 152 | 147 | 157 | 152 | 162 | 157 | 168 | 164 | .103 |
| | 11 | 96 | 86 | 102 | 92 | 106 | 96 | 111 | 100 | 138 | 130 | 143 | 135 | 147 | 140 | 152 | 145 | .125 |
| | 12 | 88 | 76 | 93 | 81 | 98 | 86 | 102 | 90 | 127 | 116 | 131 | 121 | 135 | 125 | 140 | 130 | .149 |
| | 13 | 82 | 68 | 86 | 72 | 90 | 76 | 94 | 80 | 117 | 104 | 121 | 108 | 125 | 112 | 129 | 116 | .175 |
| | 14 | 76 | 61 | 80 | 64 | 84 | 68 | 87 | 71 | 109 | 94 | 112 | 97 | 116 | 101 | 120 | 105 | .203 |
| | 15 | 71 | 54 | 74 | 57 | 78 | 61 | 82 | 64 | 102 | 85 | 105 | 88 | 108 | 91 | 112 | 95 | .233 |
| | 16 | 66 | 49 | 70 | 52 | 73 | 55 | 76 | 57 | 95 | 77 | 98 | 80 | 101 | 83 | 105 | 86 | .265 |
| | 17 | 62 | 44 | 66 | 47 | 69 | 50 | 72 | 52 | 90 | 70 | 92 | 72 | 95 | 75 | 99 | 79 | .299 |
| | 18 | 59 | 40 | 62 | 42 | 65 | 45 | 68 | 47 | 85 | 64 | 87 | 66 | 90 | 69 | 93 | 72 | .335 |
| | 19 | 56 | 36 | 59 | 39 | 62 | 41 | 64 | 43 | 80 | 58 | 83 | 61 | 85 | 63 | 88 | 65 | .373 |
| | 20 | 53 | 33 | 56 | 35 | 59 | 37 | 61 | 39 | 76 | 53 | 78 | 55 | 81 | 58 | 84 | 60 | .414 |
| | 21 | 51 | ... | 53 | ... | 56 | ... | 58 | ... | 73 | 49 | 75 | 51 | 77 | 53 | 80 | 55 | .456 |
| | 22 | 48 | ... | 51 | ... | 53 | ... | 56 | ... | 69 | 45 | 71 | 47 | 74 | 49 | 76 | 50 | .501 |
| | 23 | 46 | ... | 49 | ... | 51 | ... | 53 | ... | 66 | 41 | 68 | 43 | 71 | 45 | 73 | 47 | .548 |
| | 24 | 44 | ... | 47 | ... | 49 | ... | 51 | ... | 63 | ... | 65 | ... | 68 | ... | 70 | 43 | .596 |
| | 25 | 42 | ... | 45 | ... | 47 | ... | 49 | ... | 61 | ... | 63 | ... | 65 | ... | 67 | ... | .647 |
| | 26 | 41 | ... | 43 | ... | 45 | ... | 47 | ... | 59 | ... | 60 | ... | 62 | ... | 64 | ... | .699 |
| | 27 | 39 | ... | 41 | ... | 43 | ... | 45 | ... | 56 | ... | 58 | ... | 60 | ... | 62 | ... | .754 |
| | 28 | 38 | ... | 40 | ... | 42 | ... | 44 | ... | 54 | ... | 56 | ... | 58 | ... | 60 | ... | .811 |
| | 29 | 37 | ... | 39 | ... | 40 | ... | 42 | ... | 52 | ... | 54 | ... | 56 | ... | 58 | ... | .870 |
| | 30 | 35 | ... | 37 | ... | 39 | ... | 41 | ... | 51 | ... | 52 | ... | 54 | ... | 56 | ... | .931 |
| | 31 | 34 | ... | 36 | ... | 38 | ... | 39 | ... | 49 | ... | 51 | ... | 52 | ... | 54 | ... | .994 |
| | 32 | 33 | ... | 35 | ... | 37 | ... | 38 | ... | 48 | ... | 49 | ... | 51 | ... | 52 | ... | 1.06 |
| | 33 | 32 | ... | 34 | ... | 35 | ... | 37 | ... | 46 | ... | 48 | ... | 49 | ... | 51 | ... | 1.13 |
| | 34 | 31 | ... | 33 | ... | 34 | ... | 36 | ... | 45 | ... | 46 | ... | 48 | ... | 49 | ... | 1.20 |
| | 35 | 30 | ... | 32 | ... | 33 | ... | 35 | ... | 44 | ... | 45 | ... | 46 | ... | 48 | ... | 1.27 |
| | 36 | 29 | ... | 31 | ... | 32 | ... | 34 | ... | 42 | ... | 44 | ... | 45 | ... | 47 | ... | 1.34 |




# STANDARD BEAMS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet, uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown

# 20" I

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d" | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Wt. per foot | | **65.4** | 70.0 | 75.0 | **81.4** | 85.0 | 90.0 | 95.0 | 100.0 |
| Area. sq. in. | | 19.08 | 20.42 | 21.90 | 23.74 | 24.8 | 26.26 | 27.74 | 29.20 |
| b" | | 6.25 | 6.32 | 6.39 | 7.00 | 7.05 | 7.13 | 7.20 | 7.27 |
| t | | .500 | .567 | .641 | .600 | .653 | .726 | .800 | .873 |
| h | | 17.942 | 17.942 | 17.942 | 17.634 | 17.634 | 17.634 | 17.634 | 17.634 |
| m | | 1.029 | 1.029 | 1.029 | 1.183 | 1.183 | 1.183 | 1.183 | 1.183 |
| n | | .550 | .550 | .550 | .650 | .650 | .650 | .650 | .650 |
| f | | .60 | .60 | .60 | .70 | .70 | .70 | .70 | .70 |
| c | | 16.925 | 16.925 | 16.925 | 16.448 | 16.448 | 16.448 | 16.448 | 16.448 |
| g | | 4" | 4" | 4" | 4" | 4" | 4" | 4" | 4" |
| u | | ¾ | ¾ | ¾ | 1" | 1" | 1" | 1" | 1" |
| AXES X-X | I | 1169.5 | 1214.2 | 1263.5 | 1466.3 | 1501.7 | 1550.3 | 1599.7 | 1648.3 |
| | S | 116.95 | 121.42 | 126.35 | 146.63 | 150.17 | 155.03 | 159.97 | 164.83 |
| | r | 7.83 | 7.71 | 7.60 | 7.86 | 7.78 | 7.68 | 7.59 | 7.51 |
| AXES Y-Y | I | 27.9 | 28.9 | 30.1 | 45.8 | 47.0 | 48.7 | 50.5 | 52.4 |
| | S | 8.9 | 9.2 | 9.4 | 13.1 | 13.3 | 13.7 | 14.0 | 14.4 |
| | r | 1.21 | 1.19 | 1.17 | 1.39 | 1.38 | 1.36 | 1.35 | 1.34 |
| Coef. Str. | | 1403400 | 1457000 | 1516200 | 1759600 | 1802000 | 1860400 | 1919600 | 1978000 |
| Max.Mom." ⁄ | | 2105100 | 2185600 | 2274300 | 2639300 | 2703100 | 2790500 | 2879500 | 2966900 |
| V | | 120000 | 136100 | 153800 | 144000 | 156700 | 174200 | 192000 | 209500 |
| P. feet | | 5.85 | 5.35 | 4.93 | 6.11 | 5.75 | 5.34 | 5.00 | 4.72 |
| R | | 60400 | 71900 | 81700 | 76500 | 83300 | 92600 | 102000 | 111300 |
| W | | 56250 | 59600 | 59600 | 59600 | 59600 | 59600 | 59600 | 59600 |
| Q. feet | | 12.47 | 12.22 | 12.72 | 14.76 | 15.12 | 15.61 | 16.10 | 16.59 |
| w. lbs. | | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Rivet dia. | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ |

Live Load Deflection must not exceed 1-360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 234 | 234 | 243 | 243 | 253 | 253 | 288 | 288 | 300 | 300 | 310 | 310 | 320 | 320 | 330 | 330 | .034 |
| 8 | 175 | 174 | 182 | 181 | 190 | 190 | 220 | 220 | 225 | 225 | 233 | 233 | 240 | 240 | 247 | 247 | .060 |
| 10 | 140 | 131 | 146 | 137 | 152 | 143 | 176 | 171 | 180 | 175 | 186 | 180 | 192 | 187 | 198 | 194 | .093 |
| 11 | 128 | 116 | 132 | 120 | 138 | 126 | 160 | 151 | 164 | 155 | 169 | 161 | 175 | 167 | 180 | 172 | .113 |
| 12 | 117 | 103 | 121 | 107 | 126 | 112 | 147 | 135 | 150 | 138 | 155 | 143 | 160 | 148 | 165 | 153 | .134 |
| 13 | 108 | 91 | 112 | 95 | 117 | 100 | 135 | 120 | 139 | 124 | 143 | 128 | 148 | 133 | 152 | 137 | .158 |
| 14 | 100 | 82 | 104 | 85 | 108 | 89 | 126 | 109 | 129 | 112 | 133 | 116 | 137 | 120 | 141 | 124 | .183 |
| 15 | 94 | 74 | 97 | 77 | 101 | 80 | 117 | 98 | 120 | 101 | 124 | 105 | 128 | 108 | 132 | 112 | .210 |
| 16 | 88 | 66 | 91 | 69 | 95 | 73 | 110 | 89 | 113 | 92 | 116 | 95 | 120 | 98 | 124 | 102 | .239 |
| 17 | 83 | 60 | 86 | 63 | 89 | 66 | 104 | 81 | 106 | 83 | 109 | 86 | 113 | 90 | 116 | 93 | .270 |
| 18 | 78 | 54 | 81 | 57 | 84 | 59 | 98 | 74 | 100 | 76 | 103 | 78 | 107 | 82 | 110 | 85 | .302 |
| 19 | 74 | 49 | 77 | 52 | 80 | 54 | 93 | 68 | 95 | 69 | 98 | 72 | 101 | 75 | 104 | 77 | .336 |
| 20 | 70 | 45 | 73 | 47 | 76 | 50 | 88 | 62 | 90 | 63 | 93 | 66 | 96 | 69 | 99 | 71 | .373 |
| 21 | 67 | ... | 69 | 43 | 72 | 45 | 84 | 57 | 86 | 58 | 89 | 60 | 91 | 63 | 94 | 65 | .411 |
| 22 | 64 | ... | 66 | ... | 69 | ... | 80 | 52 | 82 | 54 | 85 | 56 | 87 | 58 | 90 | 60 | .451 |
| 23 | 61 | ... | 63 | ... | 66 | ... | 77 | 48 | 78 | 49 | 81 | 51 | 83 | 53 | 86 | 55 | .493 |
| 24 | 58 | ... | 61 | ... | 63 | ... | 73 | ... | 75 | ... | 78 | ... | 80 | 49 | 82 | 51 | .537 |
| 25 | 56 | ... | 58 | ... | 61 | ... | 70 | ... | 72 | ... | 74 | ... | 77 | ... | 79 | ... | .582 |
| 26 | 54 | ... | 56 | ... | 58 | ... | 68 | ... | 69 | ... | 72 | ... | 74 | ... | 76 | ... | .630 |
| 27 | 52 | ... | 54 | ... | 56 | ... | 65 | ... | 67 | ... | 69 | ... | 71 | ... | 73 | ... | .679 |
| 28 | 50 | ... | 52 | ... | 54 | ... | 63 | ... | 64 | ... | 66 | ... | 69 | ... | 71 | ... | .736 |
| 29 | 48 | ... | 50 | ... | 52 | ... | 61 | ... | 62 | ... | 64 | ... | 66 | ... | 68 | ... | .783 |
| 30 | 47 | ... | 49 | ... | 51 | ... | 59 | ... | 60 | ... | 62 | ... | 64 | ... | 66 | ... | .838 |
| 31 | 45 | ... | 47 | ... | 49 | ... | 57 | ... | 58 | ... | 60 | ... | 62 | ... | 64 | ... | .895 |
| 32 | 44 | ... | 46 | ... | 47 | ... | 55 | ... | 56 | ... | 58 | ... | 60 | ... | 62 | ... | .954 |
| 33 | 43 | ... | 44 | ... | 46 | ... | 53 | ... | 55 | ... | 56 | ... | 58 | ... | 60 | ... | 1.01 |
| 34 | 41 | ... | 43 | ... | 45 | ... | 52 | ... | 53 | ... | 55 | ... | 56 | ... | 58 | ... | 1.08 |
| 35 | 40 | ... | 42 | ... | 43 | ... | 50 | ... | 51 | ... | 53 | ... | 55 | ... | 57 | ... | 1.14 |
| 36 | 39 | ... | 40 | ... | 42 | ... | 49 | ... | 50 | ... | 52 | ... | 53 | ... | 55 | ... | 1.21 |
| 37 | 38 | ... | 39 | ... | 41 | ... | 48 | ... | 49 | ... | 50 | ... | 52 | ... | 53 | ... | 1.28 |
| 38 | 37 | ... | 38 | ... | 40 | ... | 46 | ... | 47 | ... | 49 | ... | 50 | ... | 52 | ... | 1.34 |

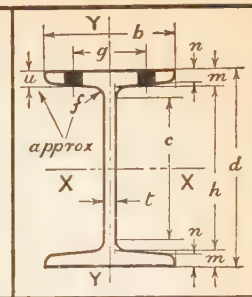
# 24" I

## STANDARD BEAMS

**DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet uniformly loaded to cause V
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions
W is Maximum Load on one Standard Connection
Q is Minimum Span in feet uniformly loaded to cause W
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is maximum diameter in flange
Allowable concentrated center loads are 50% and their deflections 80% of those shown




| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d" | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | |
| Wt. per ft.. | **79.9** | 85.0 | 90.0 | 95.0 | 100.0 | **105.9** | 110.0 | 115.0 | 115.0 | 120.0 | |
| Area. sq. in. | 23.33 | 24.84 | 26.30 | 27.79 | 29.25 | 30.98 | 32.18 | 33.67 | 33.67 | 35.13 | |
| b"..... | 7.000 | 7.063 | 7.124 | 7.186 | 7.247 | 7.875 | 7.925 | 7.987 | 8.048 | | |
| t..... | .500 | .563 | .624 | .686 | .747 | .625 | .675 | .737 | .798 | | |
| h..... | 21.716 | 21.716 | 21.716 | 21.716 | 21.716 | 21.192 | 21.192 | 21.192 | 21.192 | 21.192 | |
| m..... | 1.142 | 1.142 | 1.142 | 1.142 | 1.142 | 1.404 | 1.404 | 1.404 | 1.404 | | |
| n..... | .60 | .60 | .60 | .60 | .60 | .80 | .80 | .80 | .80 | | |
| f..... | .60 | .60 | .60 | .60 | .60 | .60 | .60 | .60 | .60 | | |
| c..... | 20.699 | 20.699 | 20.699 | 20.699 | 20.699 | 20.175 | 20.175 | 20.175 | 20.175 | | |
| g..... | 4" | 4" | 4" | 4" | 4" | 5" | 5" | 5" | 5" | | |
| u..... | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | 1 1/16 | 1 1/16 | 1 1/16 | 1 1/16 | | |
| AXES X-X I... | 2087.2 | 2159.8 | 2230.1 | 2301.5 | 2371.8 | 2811.5 | 2869.1 | 2940.5 | 3010.8 | | |
| AXES X-X S... | 173.93 | 180.00 | 185.84 | 191.80 | 197.65 | **234.30** | 239.10 | 245.04 | 250.90 | | |
| AXES X-X r... | 9.46 | 9.33 | 9.21 | 9.08 | 9.05 | 9.53 | 9.44 | 9.35 | 9.26 | | |
| AXES Y-Y I... | 42.9 | 44.2 | 45.5 | 47.0 | 48.4 | 78.9 | 80.6 | 82.8 | 84.9 | | |
| AXES Y-Y S... | 12.2 | 12.5 | 12.8 | 13.0 | 13.4 | 20.0 | 20.3 | 20.7 | 21.1 | | |
| AXES Y-Y r... | 1.36 | 1.33 | 1.32 | 1.30 | 1.29 | 1.60 | 1.58 | 1.57 | 1.56 | | |
| Coef. Str... | 2087200 | 2159800 | 2230100 | 2301500 | 2371800 | 2811500 | 2869100 | 2940500 | 3010800 | | |
| Max.Mom."/s | 3130000 | 3240000 | 3345000 | 3452000 | 3557700 | 4217000 | 4304000 | 4410800 | 4516000 | | |
| V..... | 144000 | 162100 | 179700 | 197600 | 215000 | 180000 | 194400 | 212300 | 229800 | | |
| P. feet.. | 7.25 | 6.66 | 6.20 | 5.82 | 5.51 | 7.80 | 7.38 | 6.92 | 6.55 | | |
| R..... | 61800 | 73900 | 85700 | 97400 | 106400 | 85800 | 95400 | 105000 | 113700 | | |
| W..... | 67500 | 71600 | 71600 | 71600 | 71600 | 71600 | 71600 | 71600 | 71600 | | |
| Q. feet.. | 15.5 | 15.1 | 15.6 | 16.1 | 16.6 | 19.6 | 20.0 | 20.5 | 21.0 | | |
| w. lbs... | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | | |
| Rivet dia... | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | | |

Live Load Deflection must not exceed 1-360 of the Span. Total Def. × Live Load / Tabular Load = Live Load Def.

Total Deflection in Inches for Maximum Load; laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span ft. | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 288 | 288 | 324 | 324 | 359 | 359 | 384 | 384 | 395 | 395 | 360 | 360 | 389 | 389 | 425 | 425 | 460 | 460 | |
| 8 | 261 | 261 | 270 | 270 | 279 | 279 | 288 | 288 | 296 | 296 | 352 | 352 | 359 | 359 | 368 | 368 | 376 | 376 | .050 |
| 10 | 209 | 203 | 216 | 210 | 223 | 217 | 230 | 224 | 237 | 231 | 281 | 280 | 287 | 286 | 294 | 294 | 301 | 301 | .078 |
| 12 | 174 | 160 | 180 | 166 | 186 | 172 | 192 | 178 | 198 | 184 | 234 | 223 | 239 | 228 | 245 | 234 | 251 | 241 | .112 |
| 14 | 149 | 129 | 154 | 133 | 159 | 138 | 164 | 143 | 169 | 148 | 201 | 182 | 205 | 186 | 210 | 191 | 215 | 196 | .152 |
| 16 | 130 | 105 | 135 | 109 | 139 | 113 | 144 | 118 | 148 | 122 | 176 | 151 | 179 | 154 | 184 | 159 | 188 | 163 | .199 |
| 18 | 116 | 87 | 120 | 91 | 124 | 94 | 128 | 98 | 132 | 102 | 156 | 126 | 159 | 129 | 163 | 133 | 167 | 136 | .251 |
| 20 | 104 | 73 | 108 | 76 | 111 | 79 | 115 | 82 | 119 | 85 | 141 | 107 | 143 | 109 | 147 | 113 | 151 | 116 | .310 |
| 21 | 99 | 66 | 103 | 70 | 106 | 72 | 110 | 76 | 113 | 78 | 134 | 98 | 137 | 101 | 140 | 104 | 143 | 107 | .342 |
| 22 | 95 | 62 | 98 | 64 | 101 | 66 | 105 | 70 | 108 | 72 | 128 | 91 | 130 | 93 | 134 | 96 | 137 | 99 | .375 |
| 23 | 91 | 57 | 94 | 59 | 97 | 61 | 100 | 64 | 103 | 66 | 122 | 84 | 125 | 86 | 128 | 89 | 131 | 92 | .411 |
| 24 | 87 | ... | 90 | ... | 93 | ... | 96 | 59 | 99 | 62 | 117 | 78 | 120 | 80 | 123 | 83 | 125 | 85 | .447 |
| 25 | 83 | ... | 86 | ... | 89 | ... | 92 | ... | 95 | ... | 112 | 72 | 115 | 74 | 118 | 77 | 120 | 79 | .485 |
| 26 | 80 | ... | 83 | .. | 86 | ... | 89 | ... | 91 | ... | 108 | 67 | 110 | 69 | 113 | 71 | 116 | 73 | .525 |
| 27 | 77 | ... | 80 | .. | 83 | ... | 85 | ... | 88 | ... | 104 | ... | 106 | ... | 109 | ... | 112 | .. | .566 |
| 28 | 74 | ... | 77 | .. | 80 | ... | 82 | ... | 85 | ... | 100 | ... | 102 | ... | 105 | ... | 108 | .. | .608 |
| 29 | 72 | ... | 74 | ... | 77 | ... | 79 | ... | 82 | ... | 97 | ... | 99 | ... | 101 | ... | 104 | .. | .653 |
| 30 | 70 | .. | 72 | ... | 74 | ... | 77 | ... | 79 | ... | 94 | ... | 96 | ... | 98 | ... | 100 | .. | .698 |
| 31 | 67 | .. | 70 | ... | 72 | ... | 74 | ... | 77 | ... | 91 | ... | 93 | ... | 95 | ... | 97 | .. | .746 |
| 32 | 65 | .. | 68 | ... | 70 | ... | 72 | ... | 74 | ... | 88 | ... | 90 | ... | 92 | ... | 94 | .. | .795 |
| 33 | 63 | .. | 65 | ... | 68 | ... | 70 | ... | 72 | ... | 85 | ... | 87 | ... | 89 | ... | 91 | .. | .845 |
| 34 | 61 | .. | 63 | ... | 66 | ... | 68 | ... | 70 | ... | 83 | ... | 84 | ... | 86 | ... | 89 | .. | .897 |
| 35 | 60 | ... | 62 | ... | 64 | ... | 66 | ... | 68 | ... | 80 | ... | 82 | ... | 84 | ... | 86 | .. | .950 |
| 36 | 58 | .. | 60 | ... | 62 | ... | 64 | ... | 66 | ... | 78 | ... | 80 | ... | 82 | ... | 84 | .. | 1.01 |
| 38 | 55 | ... | 57 | ... | 59 | ... | 61 | ... | 62 | ... | 74 | ... | 76 | ... | 77 | ... | 79 | .. | 1.12 |
| 40 | 52 | ... | 54 | ... | 56 | ... | 58 | ... | 59 | ... | 70 | ... | 72 | ... | 74 | ... | 75 | .. | 1.24 |
| 42 | 50 | ... | **51** | ... | 53 | ... | 55 | ... | 56 | ... | 67 | ... | 68 | ... | 72 | ... | 72 | .. | 1.37 |
| 44 | 47 | ... | 49 | ... | 51 | ... | 52 | ... | 54 | ... | 64 | ... | 65 | ... | 67 | ... | 68 | .. | 1.50 |
| 46 | 45 | ... | 47 | ... | 48 | ... | 50 | ... | 52 | ... | 61 | ... | 62 | ... | 64 | ... | 65 | .. | 1.64 |
| 48 | 43 | ... | 45 | ... | 46 | ... | 48 | ... | 49 | ... | 59 | ... | 60 | ... | 61 | ... | 63 | .. | 1.79 |
| 50 | 42 | ... | 43 | ... | 45 | ... | 46 | ... | 47 | ... | 56 | ... | 57 | ... | 59 | ... | 60 | .. | 1.94 |

# ALLOWABLE END REACTIONS FOR AMERICAN STANDARD BEAMS
## DETERMINED BY
# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

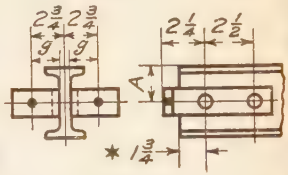
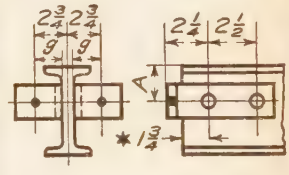
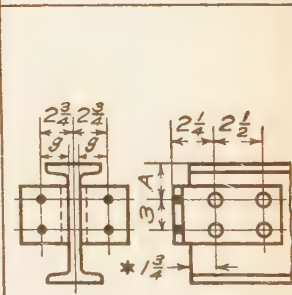
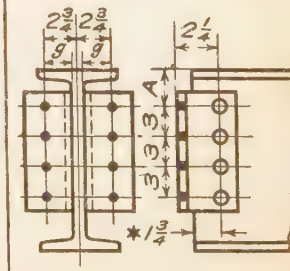
| Depth in Inches | Weight Per Foot | Web t. | Unit Stress in Buckling | Reaction R For 3½" Bearing | Min. Span For 3½" Bearing | Reaction R For 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to Develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 10.00 | .210" | 15000 | 12600 | 2.30' | 12600 | 3150 | 12600 | 2.75' |
| | 12.25 | .347 | " | 20800 | 1.56 | 20800 | 5205 | 20800 | " |
| | 14.75 | .494 | " | 29600 | 1.22 | 29600 | 7410 | 29600 | " |
| 6 | 12.50 | .230 | 15000 | 16600 | 2.63 | 16600 | 3450 | 16600 | 3.31 |
| | 14.75 | .343 | " | 24700 | 1.93 | 24700 | 5145 | 24700 | 3.30 |
| | 17.25 | .465 | " | 34500 | 1.51 | 34500 | 6975 | 34500 | 3.45 |
| 7 | 15.30 | .250 | 15000 | 19700 | 3.15 | 21000 | 3750 | 21000 | 3.85 |
| | 17.50 | .345 | " | 27200 | 2.45 | 29000 | 5175 | 29000 | " |
| | 20.00 | .450 | " | 35400 | 2.03 | 37800 | 6750 | 37800 | " |
| 8 | 18.40 | .270 | 15000 | 22300 | 3.83 | 25900 | 4050 | 25900 | 4.39 |
| | 20.50 | .349 | " | 28800 | 3.13 | 33500 | 5235 | 33500 | " |
| | 23.00 | .441 | " | 36400 | 2.65 | 42300 | 6615 | 42300 | " |
| | 25.50 | .532 | " | 43900 | 2.33 | 51100 | 7980 | 51100 | 4.40 |
| 9 | 21.80 | .290 | 15000 | 25000 | 4.52 | 31300 | 4350 | 31300 | 4.95 |
| | 25.00 | .397 | " | 34200 | 3.56 | 42900 | 5955 | 42900 | " |
| | 30.00 | .561 | " | 48400 | 2.79 | 60600 | 8415 | 60600 | " |
| | 35.00 | .724 | " | 62400 | 2.38 | 78200 | 10860 | 78200 | " |
| 10 | 25.40 | .310 | 15000 | 27900 | 5.25 | 37200 | 4650 | 37200 | 5.50 |
| | 30.00 | .447 | " | 40200 | 3.98 | 53600 | 6705 | 53600 | " |
| | 35.00 | .594 | " | 53500 | 3.27 | 71300 | 8910 | 71300 | " |
| | 40.00 | .741 | " | 66700 | 2.84 | 88900 | 11115 | 88900 | " |
| 12 | 31.80 | .350 | 15000 | 34100 | 6.32 | 44600 | 5250 | 50400 | 6.60 |
| | 35.00 | .428 | " | 41700 | 5.44 | 54600 | 6420 | 61600 | " |
| | 40.80 | .460 | " | 44900 | 5.99 | 58700 | 6900 | 66200 | " |
| | 45.00 | .565 | " | 55100 | 5.16 | 72000 | 8475 | 81400 | 6.60 |
| | 50.00 | .687 | " | 67000 | 4.50 | 87600 | 10305 | 98900 | " |
| | 55.00 | .810 | " | 79000 | 4.04 | 103300 | 12150 | 116600 | " |
| 15 | 42.90 | .410 | 14730 | 43800 | 8.07 | 55900 | 6035 | 73800 | 8.47 |
| | 45.00 | .452 | 15000 | 49200 | 7.38 | 62700 | 6780 | 81400 | 8.25 |
| | 50.00 | .550 | " | 59800 | 6.43 | 76300 | 8250 | 99000 | " |
| | 55.00 | .648 | " | 70500 | 5.77 | 89900 | 9720 | 116600 | " |
| | 60.80 | .590 | 15000 | 64200 | 7.59 | 81900 | 8850 | 106200 | 8.25 |
| | 65.00 | .672 | " | 73100 | 6.92 | 93200 | 10080 | 121000 | " |
| | 70.00 | .770 | " | 83700 | 6.30 | 106800 | 11550 | 138600 | " |
| | 75.00 | .868 | " | 94400 | 5.82 | 120400 | 13020 | 156200 | " |
| 18 | 54.70 | .460 | 14350 | 52800 | 10.07 | 66000 | 6600 | 99400 | 10.55 |
| | 60.00 | .547 | 15000 | 65600 | 8.51 | 82100 | 8205 | 118200 | 9.90 |
| | 65.00 | .629 | " | 75500 | 7.75 | 94400 | 9435 | 135900 | " |
| | 70.00 | .711 | " | 85300 | 7.17 | 106700 | 10665 | 153600 | " |
| | 75.60 | .560 | 15000 | 67200 | 11.33 | 84000 | 8400 | 121000 | 9.90 |
| | 80.00 | .632 | " | 75800 | 10.35 | 94800 | 9480 | 136500 | " |
| | 85.00 | .714 | " | 85700 | 9.47 | 107100 | 10710 | 154200 | " |
| | 90.00 | .796 | " | 95500 | 8.78 | 119400 | 11940 | 171900 | " |
| 20 | 65.40 | .500 | 14210 | 60400 | 11.63 | 74600 | 7105 | 120000 | 11.88 |
| | 70.00 | .567 | 14910 | 71900 | 10.14 | 88800 | 8450 | 136100 | 11.11 |
| | 75.00 | .641 | 15000 | 81700 | 9.28 | 101000 | 9615 | 153800 | 11.00 |
| | 81.40 | .600 | " | 76500 | 11.50 | 94500 | 9000 | 144000 | " |
| | 85.00 | .653 | 15000 | 83300 | 10.82 | 102800 | 9795 | 156700 | 11.00 |
| | 90.00 | .726 | " | 92600 | 10.05 | 114300 | 10890 | 174200 | " |
| | 95.00 | .800 | " | 102000 | 9.41 | 126000 | 12000 | 192000 | " |
| | 100.00 | .873 | " | 111300 | 8.88 | 137500 | 13095 | 209500 | " |
| 24 | 79.90 | .500 | 13010 | 61800 | 16.89 | 74800 | 6505 | 144000 | 16.10 |
| | 85.00 | .563 | 13820 | 73900 | 14.61 | 89500 | 7780 | 162100 | 14.84 |
| | 90.00 | .624 | 14450 | 85700 | 13.02 | 103700 | 9015 | 179700 | 13.94 |
| | 95.00 | .686 | 14950 | 97400 | 11.81 | 117900 | 10255 | 197600 | 13.26 |
| | 100.00 | .747 | 15000 | 106400 | 11.14 | 128900 | 11205 | 215000 | 13.19 |
| | 105.90 | .625 | 14450 | 85800 | 16.38 | 104400 | 9030 | 180000 | 13.93 |
| | 110.00 | .675 | 14870 | 95400 | 15.04 | 115400 | 10035 | 194400 | 13.37 |
| | 115.00 | .737 | 15000 | 105000 | 14.00 | 127100 | 11055 | 212300 | 13.20 |
| | 120.00 | .798 | " | 113700 | 13.24 | 137700 | 11970 | 229800 | 13.20 |

The beam web is treated as a column with fixed ends, having an effective length $l$ of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided: but in no case shall the reaction exceed the allowable shearing value V.

# CONNECTION ANGLES FOR AMERICAN STANDARD BEAMS

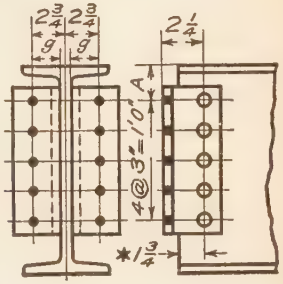
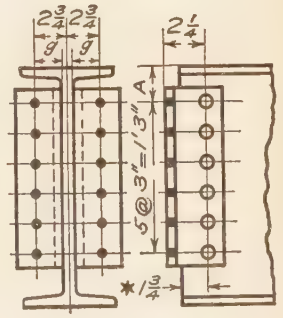
DIMENSIONS, WEIGHTS, AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

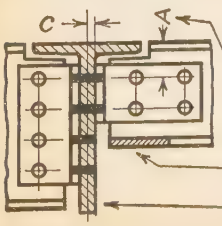
| Beam | | Connection Value | | | Framing Distance | Connection Angles | | | | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Outstanding Single Shear | | | A.I.S.C. Mark | Gage | Size and Length | Weight inc. Web Rivets | |
| Depth | Weight per foot | Web | Power Driven Rivets | Unfinished Bolts | C | | g | | | |
| 3" | 5.7 | 7650 | 11930 | 8840 | 1/8 | IC. 5.11 | 2 11/16 | 6" × 4" × 3/8" 0' — 2" Long | 5 lbs. |  |
| | 6.5 | 11296 | " | " | 3/16 | IC. 5.10 | 2 5/8 | | | |
| | 7.5 | 15706 | " | " | 1/4 | IC. 5. 9 | 2 9/16 | | | |
| 4" | 7.7 | 8550 | 11930 | 8840 | 3/16 | IC. 5.10 | 2 5/8 | | | |
| | 8.5 | 11390 | " | " | 3/16 | IC. 5.10 | 2 5/8 | | | |
| | 9.5 | 14670 | " | " | 1/4 | IC. 5. 9 | 2 9/16 | | | |
| | 10.5 | 18000 | " | " | 1/4 | IC. 5. 9 | 2 9/16 | | | |
| 5" | 10.0 | 9450 | 11930 | 8840 | 3/16 | IC. 6.10 | 2 5/8 | 6" × 4" × 3/8" 0' — 2 1/2" Long | 6 lbs. |  |
| | 12.25 | 15620 | " | " | 1/4 | IC. 6. 9 | 2 9/16 | | | |
| | 14.75 | 22230 | " | " | 5/16 | IC. 6. 8 | 2 1/2 | | | |
| 6" | 12.5 | 10350 | 11930 | 8840 | 3/16 | IC. 6.10 | 2 5/8 | | | |
| | 14.75 | 15440 | " | " | 1/4 | IC. 6. 9 | 2 9/16 | | | |
| | 17.25 | 20930 | " | " | 5/16 | IC. 6. 8 | 2 1/2 | | | |
| 7" | 15.3 | 11250 | 11930 | 8840 | 3/16 | IC. 6.10 | 2 5/8 | | | |
| | 17.5 | 15530 | " | " | 1/4 | IC. 6. 9 | 2 9/16 | | | |
| | 20.0 | 20250 | " | " | 5/16 | IC. 6. 8 | 2 1/2 | | | |
| 8" | 18.4 | 24300 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | 6" × 4" × 3/8" 0' — 5 1/2" Long | 13 lbs. |  |
| | 20.5 | 31410 | " | " | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 23.0 | 39690 | " | " | 5/16 | IC.13. 8 | 2 1/2 | | | |
| | 25.5 | 47720 | " | " | 5/16 | IC.13. 8 | 2 1/2 | | | |
| 9" | 21.8 | 26100 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 25.0 | 35730 | " | " | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 30.0 | 47720 | " | " | 3/8 | IC.13. 8 | 2 1/2 | | | |
| | 35.0 | " | " | " | 7/16 | IC.13. 6 | 2 3/8 | | | |
| 10" | 25.4 | 27900 | 23860 | 17670 | 1/4 | IC.13.10 | 2 5/8 | | | |
| | 30.0 | 40230 | " | " | 5/16 | IC.13. 8 | 2 1/2 | | | |
| | 35.0 | 47720 | " | " | 3/8 | IC.13. 7 | 2 7/16 | | | |
| | 40.0 | " | " | " | 7/16 | IC.13. 6 | 2 3/8 | | | |
| 12" | 31.8 | 31500 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 35.0 | 38520 | " | " | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 40.8 | 41400 | " | " | 5/16 | IC.13. 8 | 2 1/2 | | | |
| | 45.0 | 47720 | " | " | 3/8 | IC.13. 7 | 2 7/16 | | | |
| | 50.0 | " | " | " | 7/16 | IC.13. 6 | 2 3/8 | | | |
| | 55.0 | " | " | " | 1/2 | IC.13. 6 | 2 3/8 | | | |
| 15" | 42.9 | 36900 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | 4" × 3 1/2" × 3/8" 0' — 11 1/2" Long | 19 lbs. |  |
| | 45.0 | 40680 | " | " | 5/16 | IC.19. 8 | 2 1/2 | | | |
| | 50.0 | 47720 | " | " | 5/16 | IC.19. 8 | 2 1/2 | | | |
| | 55.0 | " | " | " | 3/8 | IC.19. 7 | 2 7/16 | | | |
| 18" | 60.8 | 47720 | 47720 | 35340 | 3/8 | IC.19. 7 | 2 7/16 | | | |
| | 65.0 | " | " | " | 3/8 | IC.19. 7 | 2 7/16 | | | |
| | 70.0 | " | " | " | 7/16 | IC.19. 6 | 2 3/8 | | | |
| | 75.0 | " | " | " | 1/2 | IC.19. 5 | 2 5/16 | | | |
| | 54.7 | 41400 | 47720 | 35340 | 5/16 | IC.19. 8 | 2 1/2 | | | |
| | 60.0 | 47720 | " | " | 5/16 | IC.19. 8 | 2 1/2 | | | |
| | 65.0 | " | " | " | 3/8 | IC.19. 7 | 2 7/16 | | | |
| | 70.0 | " | " | " | 7/16 | IC.19. 6 | 2 3/8 | | | |
| | 75.6 | 47720 | 47720 | 35340 | 3/8 | IC.19. 8 | 2 1/2 | | | |
| | 80.0 | " | " | " | 3/8 | IC.19. 7 | 2 7/16 | | | |
| | 85.0 | " | " | " | 7/16 | IC.19. 6 | 2 3/8 | | | |
| | 90.0 | " | " | " | 7/16 | IC.19. 6 | 2 3/8 | | | |

LOADS BY A. I. S. C. SPECIFICATION

# CONNECTION ANGLES FOR AMERICAN STANDARD BEAMS

DIMENSIONS, WEIGHTS AND WORKING LOADS. 3/4" POWER DRIVEN RIVETS.

| Beam | | Connection Value | | | Framing Distance | Connection Angles | | | | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Outstanding | | | | | | | |
| | | | Single Shear | | | | | | | |
| Depth | Weight per foot | Web | Power Driven Rivets | Unfinished Bolts | C | A.I.S.C. Mark | Gage g | Size and Length | Weight inc. Web Rivets | |
| 20" | 65.4 | 56250 | 59650 | 44180 | 5/16 | IC.25.8 | 2 1/2 | 4" × 3 1/2" × 3/8" 1' — 2 1/2" Long | 25 lbs. |  |
| | 70.0 | 59650 | " | " | 3/8 | IC.25.7 | 2 7/16 | | | |
| | 75.0 | " | " | " | 3/8 | IC.25.7 | 2 7/16 | | | |
| | 81.4 | " | " | " | 3/8 | IC.25.7 | 2 7/16 | | | |
| | 85.0 | 59650 | 59650 | 44180 | 3/8 | IC.25.7 | 2 7/16 | | | |
| | 90.0 | " | " | " | 7/16 | IC.25.6 | 2 3/8 | | | |
| | 95.0 | " | " | " | 7/16 | IC.25.6 | 2 3/8 | | | |
| | 100.0 | " | " | " | 1/2 | IC.25.5 | 2 5/16 | | | |
| 24" | 79.9 | 67500 | 71580 | 53020 | 5/16 | IC.30.8 | 2 1/2 | 4" × 3 1/2" × 3/8" 1' — 5 1/2" Long | 30 lbs. |  |
| | 85.0 | 71580 | " | " | 3/8 | IC.30.7 | 2 7/16 | | | |
| | 90.0 | " | " | " | 3/8 | IC.30.7 | 2 7/16 | | | |
| | 95.0 | " | " | " | 7/16 | IC.30.7 | 2 7/16 | | | |
| | 100.0 | 71580 | 71580 | 53020 | 7/16 | IC.30.6 | 2 3/8 | | | |
| | 105.9 | " | " | " | 3/8 | IC.30.7 | 2 7/16 | | | |
| | 110.0 | " | " | " | 3/8 | IC.30.7 | 2 7/16 | | | |
| | 115.0 | " | " | " | 7/16 | IC.30.6 | 2 3/8 | | | |
| | 120.0 | " | " | " | 7/16 | IC.30.6 | 2 3/8 | | | |




*Layer-out starts with this dimension at left end of beam. With beams ordered one inch short, as usual in standard shop practice, this leaves sufficient end distance or clearance at right end, in case of full allowable 3/8" underrun or 3/8" overrun in beam lengths.

When A = 3" all beams and channels from 24" 100 lb. to 5" inclusive, can be framed opposite with tops flush.

When A = 3 1/4" all beams and channels from 24" 120 lb. to 6" inclusive, excepting 8"; can be framed opposite with tops flush.

Flange must be cut away as shown, for field riveting, on all beams (excepting 5" and 8") framing opposite a larger beam which has a different size standard connection.

Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

## LOADS BY A. I. S. C. SPECIFICATION

## BEAM SUMMARY

### Pages 361—367

The beam summary affords the quickest and easiest method of selecting the most economical beam section to use for any total continuous uniformly distributed load and any span in feet.

## A.I.S.C. CONNECTION ANGLES

The A. I. S. C. mark on drawings gives useful information without further reference to a connection angle chart. The figures, immediately following the Institute's symbol IC, are the weight of the connection, including the web rivets, and the last figures are the number of sixteenths of an inch greater than 2″ in the gauge of the outstanding legs. Thus, connection angles IC.49.7 weigh 49 pounds, including web rivets, and the gauge in the outstanding leg is $2\frac{7}{16}$″. A further discussion on the A. I. S. C. connection angle appears on page 227.

# Part IV

# Section 5

## BETHLEHEM BEAM SECTIONS

### Dimensions—Technical Functions

### Allowable Total Loads by A. I. S. C. Specification

### Allowable End Reactions—Standard Connection Angles

| Usual Stock Sizes | | | | | |
|---|---|---|---|---|---|
| Depth | Weight | Depth | Weight | Depth | Weight |
| 8″ | 17.5 * | 16″ | 40.0 * | 26″ | 91.0 * |
| 9″ | 20.5 * | 18″ | 49.0 * | 28″ | 97.0 * |
| 10″ | 23.5 * | 20″ | 59.5 * | 30″ | 121.0 * |
| 12″ | 28.0 * | 22″ | 62.5 * | 33″ | 135.0 * |
| 14″ | 33.0 * | 24″ | 73.5 * | 36″ | 155.0 * |
| 15″ | 38.5 * | | | | |

| Manufacturers Section Index | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sec. Index | Depth | Weight | | | | Sec. Index | Depth | Weight | | | | |
| B 8 | 8″ | 17.5 | 19.0 | | | B 20 | 20″ | 56.0 | 59.5 | 62.0 | 64.5 | |
| B 9 | 9″ | 20.5 | 22.0 | | | B 20a | 20″ | 68.5 | 73.0 | 78.0 | | |
| B 10 | 10″ | 21.0 | 23.5 | 26.0 | 28.5 | B 22 | 22″ | 54.5 | 58.0 | 62.5 | 67.5 | 73.0 |
| B 12 | 12″ | 25.0 | 28.0 | 31.5 | 36.0 | B 22a | 22″ | 77.0 | 83.0 | 89.0 | 96.5 | |
| B 12a | 12″ | 40.0 | 44.0 | 48.5 | | B 24 | 24″ | 70.0 | 73.5 | 79.5 | | |
| B 14 | 14″ | 30.0 | 33.0 | 37.5 | 42.0 | B 24a | 24″ | 84.5 | 90.5 | | | |
| B 15 | 15″ | 36.0 | 38.5 | 40.0 | 42.5 | B 24b | 24″ | 95.5 | 99.5 | 104.5 | | |
| B 15a | 15″ | 46.0 | 50.5 | 54.5 | 59.5 | B 26 | 26″ | 81.0 | 85.5 | 91.0 | 98.0 | |
| B 15b | 15″ | 71.5 | | | | B 28 | 28″ | 85.0 | 91.0 | 97.0 | 104.0 | |
| B 16 | 16″ | 35.0 | 40.0 | 45.0 | 50.0 | | | 112.0 | 119.0 | 133.0 | | |
| B 16a | 16″ | 56.5 | 60.5 | 66.0 | 71.5 | B 30 | 30″ | 110.0 | 115.0 | 121.0 | 129.0 | |
| B 18 | 18″ | 47.0 | 49.0 | 52.0 | 54.5 | | | 137.0 | 149.0 | 163.0 | | |
| B 18a | 18″ | 59.0 | 64.5 | 69.0 | 74.0 | B 33 | 33″ | 125.0 | 135.0 | 143.0 | 152.0 | 165.0 |
| | | | | | | B 36 | 36″ | 147.0 | 155.0 | 164.0 | 173.0 | 190.0 |

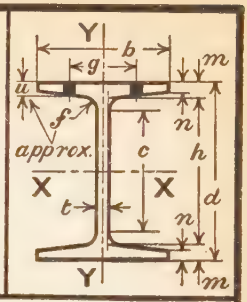
# 8" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | |
|---|---|---|---|
| Depth = d". | | 8.00 | 8.06 |
| Wt. per foot. | | 17.5 | 19.0 |
| Area. Sq. In.. | | 5.20 | 5.68 |
| b"..... | | 5.250 | 5.270 |
| t..... | | .250 | .270 |
| h..... | | 7.164 | 7.164 |
| m..... | | .418 | .448 |
| n..... | | .210 | .240 |
| f..... | | .30 | .30 |
| c..... | | 6.625 | 6.625 |
| g..... | | 2¼ | 2¼ |
| u..... | | 11/32 | ⅜ |
| AXES X-X | I.... | 57.7 | 63.7 |
| | S.... | 14.43 | 15.81 |
| | r.... | 3.33 | 3.35 |
| AXES Y-Y | I.... | 6.39 | 7.20 |
| | S.... | 2.44 | 2.73 |
| | r.... | 1.11 | 1.13 |
| Coef. Str.... | | 173100 | 189700 |
| Max. Mom. "/# | | 259700 | 284500 |
| V..... | | 24000 | 26100 |
| P. feet.. | | 3.61 | 3.63 |
| R..... | | 20600 | 22300 |
| W..... | | 22500 | 23900 |
| Q. feet.. | | 3.85 | 3.97 |
| w. lbs... | | 13 | 13 |
| Rivet dia.... | | ¾ | ¾ |

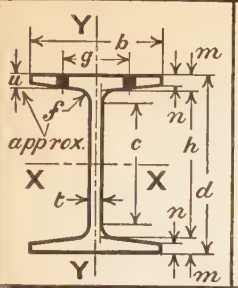
Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Total Deflection in inches for Maximum Load; Laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|
| 2 | 48.0 | 48.0 | 52.2 | 52.2 | |
| 3 | 48.0 | 48.0 | 52.2 | 52.2 | |
| 4 | 43.3 | 43.3 | 47.4 | 47.4 | .037 |
| 5 | 34.6 | 34.6 | 38.0 | 38.0 | .058 |
| 6 | 28.9 | 28.9 | 31.6 | 31.6 | .084 |
| 7 | 24.7 | 24.3 | 27.1 | 26.7 | .114 |
| 8 | 21.6 | 20.6 | 23.7 | 22.6 | .149 |
| 9 | 19.2 | 17.6 | 21.1 | 19.4 | .189 |
| 10 | 17.3 | 15.2 | 19.0 | 16.8 | .233 |
| 11 | 15.7 | 13.3 | 17.2 | 14.6 | .281 |
| 12 | 14.4 | 11.6 | 15.8 | 12.8 | .335 |
| 13 | 13.3 | 10.3 | 14.6 | 11.3 | .394 |
| 14 | 12.4 | 9.1 | 13.6 | 10.0 | .456 |
| 15 | 11.5 | 8.0 | 12.6 | 8.8 | .524 |
| 16 | 10.8 | 7.2 | 11.9 | 8.0 | .596 |
| 17 | 10.2 | 6.5 | 11.2 | 7.1 | .674 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration

V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 9″ B

| | | | | |
|---|---|---|---|---|
| Depth = d″. | | 9.00 | 9.06 | Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load |
| Wt. per foot. | | 20.5 | 22.0 | |
| Area. Sq. In.. | | 6.09 | 6.51 | |
| b″..... | | 5.500 | 5.510 | |
| t..... | | .250 | .260 | |
| h..... | | 8.062 | 8.062 | |
| m..... | | .469 | 499 | |
| n..... | | .250 | .280 | |
| f..... | | .30 | .30 | |
| c..... | | 7.500 | 7.500 | |
| g..... | | 2½ | 2½ | |
| u..... | | ⅜ | 13/32 | |
| AXES | X-X I.... | 86.5 | 93.9 | |
| | X-X S.... | 19.22 | 20.73 | |
| | X-X r.... | 3.77 | 3.80 | |
| | Y-Y I.... | 8.54 | 9.42 | |
| | Y-Y S.... | 3.10 | 3.42 | |
| | Y-Y r.... | 1.18 | 1.20 | |
| Coef. Str.... | | 230700 | 248700 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max.Mom.″/₈ | | 346000 | 373100 | |
| V..... | | 27000 | 28300 | |
| P. feet.. | | 4.27 | 4.39 | |
| R..... | | 21300 | 22400 | |
| W..... | | 22500 | 23400 | |
| Q. feet.. | | 5.13 | 5.31 | |
| w. lbs... | | 13 | 13 | |
| Rivet dia.... | | ¾ | ¾ | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|
| 3 | 54.0 | 54.0 | 56.6 | 56.6 | |
| 4 | 54.0 | 54.0 | 56.6 | 56.6 | |
| 5 | 46.1 | 46.1 | 49.7 | 49.7 | .052 |
| 6 | 38.5 | 38.5 | 41.5 | 41.5 | .074 |
| 7 | 33.0 | 32.8 | 35.5 | 35.4 | .101 |
| 8 | 28.8 | 27.7 | 31.1 | 30.0 | .132 |
| 9 | 25.6 | 23.9 | 27.6 | 25.7 | .168 |
| 10 | 23.1 | 20.7 | 24.9 | 22.4 | .207 |
| 11 | 21.0 | 18.1 | 22.6 | 19.5 | .250 |
| 12 | 19.2 | 15.9 | 20.7 | 17.2 | .298 |
| 13 | 17.7 | 14.0 | 19.1 | 15.2 | .350 |
| 14 | 16.5 | 12.5 | 17.8 | 13.5 | .406 |
| 15 | 15.4 | 11.1 | 16.6 | 12.0 | .466 |
| 16 | 14.4 | 9.9 | 15.5 | 10.7 | .530 |
| 17 | 13.6 | 9.0 | 14.6 | 9.6 | .599 |
| 18 | 12.8 | 8.0 | 13.8 | 8.7 | .670 |
| 19 | 12.1 | ... | 13.1 | ... | .747 |

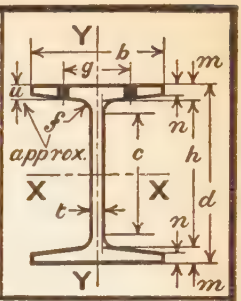
# 10" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W. is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



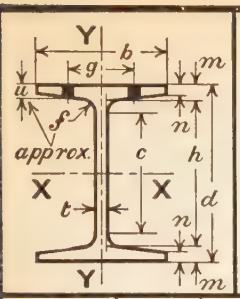

| | | | | | |
|---|---|---|---|---|---|
| Depth = d". | | 9.90 | 10.00 | 10.09 | 10.19 |
| Wt. per foot. | | 21.0 | 23.5 | 26.0 | 28.5 |
| Area. Sq. In.. | | 6.28 | 6.96 | 7.68 | 8.41 |
| b"..... | | 5.740 | 5.750 | 5.770 | 5.785 |
| t..... | | .240 | .250 | .270 | .285 |
| h..... | | 8.972 | 8.972 | 8.972 | 8.972 |
| m..... | | .464 | .514 | .559 | .609 |
| n..... | | .235 | .285 | .330 | .380 |
| f..... | | .30 | .30 | .30 | .30 |
| c..... | | 8.375 | 8.375 | 8.375 | 8.375 |
| g..... | | 2¾ | 2¾ | 2¾ | 2¾ |
| u..... | | 11/32 | 13/32 | 15/32 | ½ |
| AXES | X-X I.... | 108.1 | 123.2 | 137.9 | 154.1 |
| | X-X S.... | 21.84 | 24.64 | 27.33 | 30.25 |
| | X-X r.... | 4.15 | 4.21 | 4.24 | 4.28 |
| | Y-Y I.... | 9.30 | 10.9 | 12.5 | 14.2 |
| | Y-Y S.... | 3.24 | 3.80 | 4.33 | 4.92 |
| | Y-Y r.... | 1.22 | 1.25 | 1.28 | 1.30 |
| Coef. Str.... | | 262100 | 295700 | 328000 | 362900 |
| Max. Mom. "# | | 393100 | 443500 | 492000 | 544400 |
| V..... | | 28500 | 30000 | 32700 | 34800 |
| P. feet.. | | 4 60 | 4.93 | 5.02 | 5.21 |
| R..... | | 20200 | 21300 | 23700 | 25400 |
| W..... | | 21600 | 22500 | 23900 | 23900 |
| Q. feet.. | | 6.07 | 6.57 | 6.86 | 7.59 |
| w. lbs... | | 13 | 13 | 13 | 13 |
| Rivet dia.... | | ¾ | ¾ | ¾ | ¾ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 57.0 | 57.0 | 60 0 | 60.0 | 65.4 | 65.4 | 69.6 | 69.6 | |
| 4 | 57.0 | 57.0 | 60.0 | 60.0 | 65.4 | 65.4 | 69.6 | 69.6 | |
| 5 | 52.4 | 52.4 | 59.1 | 59.1 | 65.4 | 65.4 | 69.6 | 69.6 | .047 |
| 6 | 43.7 | 43.7 | 49.3 | 49.3 | 54.7 | 54.7 | 60.5 | 60.5 | .067 |
| 7 | 37.5 | 37.5 | 42.2 | 42.2 | 46.9 | 46.9 | 51.8 | 51.8 | .091 |
| 8 | 32.8 | 32.0 | 37.0 | 36.1 | 41.0 | 40.0 | 45.4 | 44.3 | .119 |
| 9 | 29.1 | 27.5 | 32.9 | 31.1 | 36.4 | 34.4 | 40.3 | 38.1 | .151 |
| 10 | 26.2 | 23.9 | 29.6 | 27.0 | 32.8 | 30.0 | 36.3 | 33.2 | .186 |
| 11 | 23.8 | 20.9 | 26.9 | 23.6 | 29.8 | 26.2 | 33.0 | 29.1 | .225 |
| 12 | 21.9 | 18.5 | 24.6 | 20.8 | 27.3 | 23.1 | 30.2 | 25.6 | .268 |
| 13 | 20.2 | 16.4 | 22.7 | 18.4 | 25.2 | 20.5 | 27.9 | 22.7 | .315 |
| 14 | 18.7 | 14.5 | 21.1 | 16.4 | 23.4 | 18.3 | 25.9 | 20.2 | .365 |
| 15 | 17.5 | 13.0 | 19.7 | 14.7 | 21.9 | 16.4 | 24.2 | 18.1 | .419 |
| 16 | 16.4 | 11.7 | 18.5 | 13.2 | 20.5 | 14.7 | 22.7 | 16.3 | .477 |
| 17 | 15.4 | 10.5 | 17.4 | 11.9 | 19.3 | 13.2 | 21.3 | 14.6 | .539 |
| 18 | 14.6 | 9.5 | 16.4 | 10.7 | 18.2 | 11.9 | 20.2 | 13.2 | .603 |
| 19 | 13.8 | 8.6 | 15.6 | 9.7 | 17.3 | 10.8 | 19.1 | 11.9 | .672 |
| 20 | 13.1 | ... | 14.8 | ... | 16.4 | ... | 18.2 | ... | .745 |
| 21 | 12.5 | ... | 14.1 | ... | 15.6 | ... | 17.3 | ... | .821 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration

V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 12″ B

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 11.88 | 12.00 | 12.12 | 12.25 | 12.00 | 12.12 | 12.25 | Live Load deflection must not exceed 1/360 of the Span. |
| Wt. per foot. | | 25.0 | 28.0 | 31.5 | 36.0 | 40.0 | 44.0 | 48.5 | |
| Area. Sq. In.. | | 7.44 | 8.28 | 9.36 | 10.58 | 11.80 | 12.97 | 14.28 | |
| b″..... | | 6.495 | 6.500 | 6.525 | 6.555 | 6.750 | 6.780 | 6.815 | |
| t..... | | .240 | .245 | .270 | .300 | .330 | .360 | .395 | |
| h..... | | 10.900 | 10.900 | 10.900 | 10.900 | 10.530 | 10.530 | 10.530 | |
| m..... | | .490 | .550 | .610 | .675 | .735 | .795 | .860 | |
| n..... | | .230 | .290 | .350 | .415 | .468 | .528 | .593 | |
| f..... | | .35 | .35 | .35 | .35 | .40 | .40 | .40 | |
| c..... | | 10.250 | 10.250 | 10.250 | 10.250 | 9.750 | 9.750 | 9.750 | |
| g..... | | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | |
| u..... | | 3/8 | 7/16 | 1/2 | 9/16 | 23/32 | 25/32 | 27/32 | |
| AXES | X-X I.... | 185.1 | 213.6 | 245.7 | 281.8 | 301.2 | 335.1 | 373.2 | Live Load Def. = Total Def. × Live Load / Tabular Load |
| | X-X S.... | 31.16 | 35.60 | 40.54 | 46.01 | 50.20 | 55.30 | 60.93 | |
| | X-X r.... | 4.99 | 5.08 | 5.12 | 5.16 | 5.05 | 5.08 | 5.11 | |
| | Y-Y I.... | 13.6 | 16.4 | 19.4 | 22.7 | 27.6 | 31.1 | 35.1 | |
| | Y-Y S.... | 4.19 | 5.04 | 5.93 | 6.93 | 8.18 | 9.18 | 10.29 | |
| | Y-Y r.... | 1.35 | 1.41 | 1.44 | 1.46 | 1 53 | 1 55 | 1.57 | |
| Coef. Str.... | | 373900 | 427200 | 486500 | 552100 | 602400 | 663600 | 731200 | Total Deflection in inches for Maximum Load: Laterally fixed beam. |
| Max. Mom. "/" | | 560900 | 640800 | 729800 | 828100 | 903600 | 995300 | 1096700 | |
| V..... | | 34200 | 35300 | 39300 | 44100 | 47500 | 52400 | 58100 | |
| P. feet.. | | 5.47 | 6.05 | 6.19 | 6.26 | 6.34 | 6 33 | 6 29 | |
| R..... | | 19900 | 20500 | 23800 | 27800 | 31700 | 35300 | 38900 | |
| W..... | | 21600 | 22100 | 23860 | 23860 | 23860 | 23860 | 23860 | |
| Q. feet.. | | 8.66 | 9.67 | 10.18 | 11.55 | 12.60 | 13.88 | 15.30 | |
| w. lbs... | | 13 | 13 | 13 | 13 | 13 | 13 | 13 | |
| Rivet dia.... | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

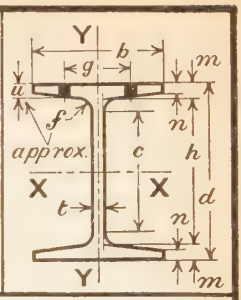
| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 68 | 68 | 71 | 71 | 79 | 79 | 88 | 88 | 95 | 95 | 105 | 105 | 116 | 116 | |
| 4 | 68 | 68 | 71 | 71 | 79 | 79 | 88 | 88 | 95 | 95 | 105 | 105 | 116 | 116 | |
| 5 | 68 | 68 | 71 | 71 | 79 | 79 | 88 | 88 | 95 | 95 | 105 | 105 | 116 | 116 | |
| 6 | 62 | 62 | 71 | 71 | 79 | 79 | 88 | 88 | 95 | 95 | 105 | 105 | 116 | 116 | .056 |
| 7 | 53 | 53 | 61 | 61 | 70 | 70 | 79 | 79 | 86 | 86 | 95 | 95 | 104 | 104 | .076 |
| 8 | 47 | 47 | 53 | 53 | 61 | 61 | 69 | 69 | 75 | 75 | 83 | 83 | 91 | 91 | .099 |
| 9 | 42 | 41 | 47 | 46 | 54 | 53 | 61 | 60 | 67 | 66 | 74 | 73 | 81 | 80 | .126 |
| 10 | 37 | 35 | 43 | 41 | 49 | 47 | 55 | 52 | 60 | 58 | 66 | 63 | 73 | 70 | .155 |
| 11 | 34 | 31 | 39 | 36 | 44 | 41 | 50 | 46 | 55 | 51 | 60 | 56 | 66 | 62 | .188 |
| 12 | 31 | 28 | 36 | 32 | 41 | 37 | 46 | 41 | 50 | 45 | 55 | 50 | 61 | 55 | .223 |
| 13 | 29 | 25 | 33 | 28 | 37 | 32 | 42 | 36 | 46 | 40 | 51 | 45 | 56 | 49 | .263 |
| 14 | 27 | 22 | 31 | 26 | 35 | 29 | 39 | 33 | 43 | 36 | 47 | 40 | 52 | 44 | .304 |
| 15 | 25 | 20 | 28 | 22 | 32 | 26 | 37 | 30 | 40 | 33 | 44 | 36 | 49 | 40 | .341 |
| 16 | 23 | 18 | 27 | 21 | 30 | 23 | 35 | 27 | 38 | 30 | 41 | 33 | 46 | 37 | .398 |
| 17 | 22 | 16 | 25 | 19 | 29 | 22 | 32 | 24 | 35 | 27 | 39 | 30 | 43 | 33 | .449 |
| 18 | 21 | 15 | 24 | 17 | 27 | 19 | 31 | 22 | 33 | 24 | 37 | 27 | 41 | 30 | .503 |
| 19 | 20 | 14 | 22 | 15 | 26 | 18 | 29 | 20 | 32 | 23 | 35 | 25 | 38 | 27 | .560 |
| 20 | 19 | 13 | 21 | 14 | 24 | 16 | 28 | 19 | 30 | 20 | 33 | 23 | 37 | 25 | .621 |
| 21 | 18 | 11 | 20 | 13 | 23 | 15 | 26 | 17 | 29 | 19 | 32 | 21 | 35 | 23 | .684 |
| 22 | 17 | ... | 19 | ... | 22 | ... | 25 | ... | 27 | 17 | 30 | 19 | 33 | 21 | .751 |
| 23 | 16 | ... | 19 | ... | 21 | ... | 24 | ... | 26 | ... | 29 | ... | 32 | ... | .822 |
| 24 | 16 | ... | 18 | ... | 20 | ... | 23 | ... | 25 | ... | 28 | ... | 30 | ... | .894 |
| 25 | 15 | ... | 17 | ... | 19 | ... | 22 | ... | 24 | ... | 27 | ... | 29 | ... | .970 |

# 14" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



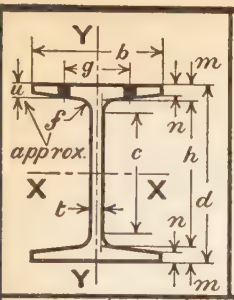

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d". | | 13.88 | | 14 00 | | 14 12 | | 14 25 | |
| Wt. per foot. | | 30.0 | | 33.0 | | 37.5 | | 42 0 | |
| Area. Sq. In.. | | 8.89 | | 9.70 | | 11.07 | | 12.46 | |
| b"..... | | 6.750 | | 6.750 | | 6.790 | | 6.825 | |
| t..... | | .265 | | .265 | | .305 | | .340 | |
| h..... | | 12.824 | | 12 824 | | 12.824 | | 12.824 | |
| m..... | | .528 | | .588 | | .648 | | .713 | |
| n..... | | .258 | | .318 | | .378 | | .443 | |
| f..... | | .40 | | .40 | | .40 | | .40 | |
| c..... | | 12.125 | | 12 125 | | 12.125 | | 12.125 | |
| g..... | | 3½ | | 3½ | | 3½ | | 3½ | |
| u..... | | 13/32 | | 15/32 | | ½ | | 19/32 | |
| AXES X-X | I.... | 294.9 | | 334.3 | | 383.7 | | 436.5 | |
| | S.... | 42 49 | | 47.76 | | 54 35 | | 61 26 | |
| | r.... | 5 76 | | 5.87 | | 5.89 | | 5.92 | |
| AXES Y-Y | I.... | 16.9 | | 19.9 | | 23.4 | | 27.3 | |
| | S.... | 4.99 | | 5.90 | | 6.91 | | 8.00 | |
| | r.... | 1.38 | | 1 43 | | 1.46 | | 1.48 | |
| Coef. Str.... | | 509900 | | 573100 | | 652200 | | 735200 | |
| Max. Mom. "# | | 764900 | | 859600 | | 978300 | | 1102700 | |
| V..... | | 44100 | | 44500 | | 51700 | | 58100 | |
| P. feet.. | | 5.78 | | 6.44 | | 6 31 | | 6 33 | |
| R..... | | 22900 | | 22800 | | 28300 | | 33100 | |
| W..... | | 23900 | | 23900 | | 27500 | | 30600 | |
| Q. feet.. | | 10.67 | | 11.99 | | 11.86 | | 12.01 | |
| w. lbs... | | 19 | | 19 | | 19 | | 19 | |
| Rivet dia.... | | ¾ | | ¾ | | ¾ | | ¾ | |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 88.2 | 88.2 | 89.0 | 89 0 | 103 | 103 | 116 | 116 | |
| 6 | 85 0 | 85.0 | 89.0 | 89.0 | 103 | 103 | 116 | 116 | |
| 7 | 72.8 | 72.8 | 81.9 | 81.9 | 93.2 | 93 2 | 105 | 105 | |
| 8 | 63.7 | 63.7 | 71 6 | 71.6 | 81.5 | 81 5 | 91 9 | 91 9 | |
| 9 | 56.7 | 55 8 | 63.7 | 62 7 | 72 5 | 71 5 | 81.7 | 80 7 | .108 |
| 10 | 51.0 | 49.0 | 57.3 | 55.0 | 65.2 | 62 7 | 73 5 | 70 7 | 133 |
| 11 | 46.4 | 43.3 | 52.1 | 48.6 | 59 3 | 55 4 | 66.8 | 62 5 | .161 |
| 12 | 42.5 | 38.5 | 47.8 | 43.3 | 54.4 | 49 4 | 61 3 | 55 7 | .192 |
| 13 | 39.2 | 34.4 | 44 1 | 38.7 | 50 2 | 44 1 | 56 6 | 49 9 | .225 |
| 14 | 36.4 | 30.9 | 40 9 | 34.7 | 46.6 | 39 7 | 52 5 | 44.8 | .261 |
| 15 | 34.0 | 27 9 | 38.2 | 31.3 | 43 5 | 35.8 | 49 0 | 40 4 | .299 |
| 16 | 31 9 | 25.2 | 35 8 | 28.3 | 40 8 | 32 4 | 46 0 | 36.6 | .341 |
| 17 | 30 0 | 22.9 | 33 7 | 25 7 | 38 4 | 29 4 | 43 2 | 33 2 | .384 |
| 18 | 28 3 | 20 8 | 31.8 | 23 4 | 36 2 | 26 7 | 40 8 | 30 2 | .431 |
| 19 | 26.8 | 19 0 | 30.2 | 21.4 | 34 3 | 24 4 | 38 7 | 27 6 | .480 |
| 20 | 25.5 | 17.4 | 28.7 | 19.5 | 32 6 | 22 3 | 36 8 | 25 3 | .532 |
| 21 | 24 3 | 15.9 | 27 3 | 17 9 | 31 1 | 20 5 | 35 0 | 23 1 | .587 |
| 22 | 23 2 | 14.6 | 26 0 | 16.4 | 29 6 | 18 7 | 33 1 | 21.2 | .644 |
| 23 | 22 2 | .... | 24 9 | .. | 28 4 | .... | 32 0 | .... | .704 |
| 24 | 21 3 | .... | 23 9 | .... | 27.2 | .... | 30 6 | .... | .766 |
| 25 | 20.4 | .... | 22.9 | .... | 26.1 | .... | 29.4 | .... | .831 |
| 26 | 19 6 | .... | 22 0 | .... | 25 1 | .... | 28 3 | .... | .899 |
| 27 | 18 9 | .... | 21.2 | .... | 24 2 | .... | 27 2 | .... | .969 |
| 28 | 18 2 | .... | 20 5 | .... | 23 3 | .... | 26 3 | .... | 1.043 |
| 29 | 17 6 | .... | 19.8 | .... | 22.5 | .... | 25 4 | .... | 1.119 |
| 30 | 17.0 | .... | 19.1 | .... | 21.7 | .... | 24.5 | .... | 1.197 |




# BETHLEHEM BEAMS

## 15" B

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d". | | 14.91 | 15.00 | 15.03 | 15.09 | 14.75 | 14.88 | 15.00 | 15.12 | 15.00 |
| Wt. per foot. | | 36.0 | 38.5 | 40.0 | 42.5 | 46.0 | 50.5 | 54.5 | 59.5 | 71.5 |
| Area. Sq. In.. | | 10.61 | 11.37 | 11.80 | 12.50 | 13.63 | 14.84 | 16.05 | 17.49 | 21.04 |
| b"..... | | 6.740 | 6.750 | 6.765 | 6.785 | 6.955 | 6.975 | 7.000 | 7.040 | 7.500 |
| t..... | | .280 | .290 | .305 | .325 | .365 | .385 | .410 | .450 | .520 |
| h..... | | 13.662 | 13.662 | 13.662 | 13.662 | 13.250 | 13.250 | 13.250 | 13.250 | 12.848 |
| m..... | | .624 | .669 | .684 | .714 | .750 | .815 | .875 | .935 | 1.076 |
| n..... | | .355 | .400 | .415 | .445 | .475 | .540 | .600 | .660 | .785 |
| f..... | | .40 | .40 | .40 | .40 | .50 | .50 | .50 | .50 | .60 |
| c..... | | 12.875 | 12.875 | 12.875 | 12.875 | 12.375 | 12.375 | 12.375 | 12.375 | 11.750 |
| g..... | | 3½ | 3½ | 3½ | 3½ | 3½ | 3½ | 3½ | 3½ | 3¾ |
| u..... | | ½ | 17/32 | 9/16 | 19/32 | ⅝ | 11/16 | ¾ | 13/16 | 15/16 |
| AXES X-X | I.... | 410.9 | 447.6 | 463.3 | 492.0 | 508.2 | 563.3 | 617.0 | 676.2 | 799.5 |
| | S.... | 55.12 | 59.68 | 61.65 | 65.21 | 68.91 | 75.71 | 82.27 | 89.44 | 106.60 |
| | r.... | 6.22 | 6.27 | 6.27 | 6.27 | 6.11 | 6.16 | 6.20 | 6.22 | 6.16 |
| AXES Y-Y | I.... | 21.7 | 24.1 | 25.1 | 26.9 | 30.8 | 34.7 | 38.6 | 42.8 | 60.9 |
| | S.... | 6.45 | 7.15 | 7.42 | 7.93 | 8.85 | 9.96 | 11.0 | 12.2 | 16.2 |
| | r.... | 1.43 | 1.46 | 1.46 | 1.47 | 1.50 | 1.53 | 1.55 | 1.56 | 1.70 |
| Coef. Str.... | | 661400 | 716200 | 739800 | 782500 | 826900 | 908500 | 987200 | 1073300 | 1279200 |
| Max. Mom. "# | | 992100 | 1074200 | 1109700 | 1173700 | 1240300 | 1362800 | 1480800 | 1610000 | 1918800 |
| V..... | | 50100 | 52200 | 55000 | 58900 | 64600 | 68700 | 73800 | 81700 | 93600 |
| P. feet.. | | 6.60 | 6.86 | 6.73 | 6 64 | 6.40 | 6.61 | 6.69 | 6.57 | 6.83 |
| R..... | | 24800 | 26200 | 28400 | 31300 | 37400 | 40100 | 43800 | 48900 | 56600 |
| W..... | | 25200 | 26100 | 27500 | 29300 | 32900 | 34700 | 36900 | 40500 | 46800 |
| Q. feet.. | | 13.12 | 13.72 | 13.45 | 13.35 | 12.57 | 13.09 | 13 38 | 13.25 | 13.67 |
| w. lbs... | | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| Rivet dia.... | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 100 | 100 | 104 | 104 | 110 | 110 | 118 | 118 | 129 | 129 | 137 | 137 | 148 | 148 | 163 | 163 | 187 | 187 | |
| 5 | 100 | 100 | 104 | 104 | 110 | 110 | 118 | 118 | 129 | 129 | 137 | 137 | 148 | 148 | 163 | 163 | 187 | 187 | |
| 6 | 100 | 100 | 104 | 104 | 110 | 110 | 118 | 118 | 129 | 129 | 137 | 137 | 148 | 148 | 163 | 163 | 187 | 187 | |
| 7 | 94 | 94 | 102 | 102 | 106 | 106 | 112 | 112 | 118 | 118 | 130 | 130 | 141 | 141 | 153 | 153 | 183 | 183 | .061 |
| 8 | 83 | 83 | 90 | 90 | 92 | 92 | 98 | 98 | 103 | 103 | 114 | 114 | 123 | 123 | 134 | 134 | 160 | 160 | .079 |
| 9 | 73 | 72 | 80 | 79 | 82 | 81 | 87 | 86 | 92 | 91 | 101 | 100 | 110 | 109 | 119 | 118 | 142 | 142 | .101 |
| 10 | 66 | 63 | 72 | 69 | 74 | 71 | 78 | 75 | 83 | 80 | 91 | 88 | 99 | 96 | 107 | 104 | 128 | 126 | .124 |
| 11 | 60 | 56 | 65 | 61 | 67 | 63 | 71 | 66 | 75 | 71 | 83 | 78 | 90 | 85 | 98 | 93 | 116 | 112 | .150 |
| 12 | 55 | 50 | 60 | 54 | 62 | 56 | 65 | 59 | 69 | 63 | 76 | 70 | 82 | 75 | 89 | 82 | 107 | 100 | .179 |
| 13 | 51 | 45 | 55 | 48 | 57 | 50 | 60 | 53 | 64 | 57 | 70 | 62 | 76 | 68 | 83 | 74 | 98 | 90 | .210 |
| 14 | 47 | 40 | 51 | 43 | 53 | 45 | 56 | 48 | 59 | 51 | 65 | 56 | 71 | 61 | 77 | 67 | 91 | 81 | .243 |
| 15 | 44 | 36 | 48 | 39 | 49 | 40 | 52 | 43 | 55 | 46 | 61 | 51 | 66 | 55 | 72 | 60 | 85 | 73 | .279 |
| 16 | 41 | 32 | 45 | 36 | 46 | 36 | 49 | 39 | 52 | 42 | 57 | 46 | 62 | 50 | 67 | 54 | 80 | 67 | .318 |
| 17 | 39 | 30 | 42 | 32 | 43 | 33 | 46 | 35 | 49 | 38 | 53 | 41 | 58 | 45 | 63 | 49 | 75 | 61 | .359 |
| 18 | 37 | 27 | 40 | 29 | 41 | 30 | 43 | 32 | 46 | 34 | 50 | 38 | 55 | 41 | 60 | 45 | 71 | 56 | .402 |
| 19 | 35 | 25 | 38 | 27 | 39 | 28 | 41 | 29 | 44 | 32 | 48 | 35 | 52 | 38 | 56 | 41 | 67 | 51 | .448 |
| 20 | 33 | 22 | 36 | 24 | 37 | 25 | 39 | 27 | 41 | 29 | 45 | 31 | 49 | 34 | 54 | 38 | 64 | 47 | .497 |
| 21 | 32 | 21 | 34 | 22 | 35 | 23 | 37 | 24 | 39 | 26 | 43 | 29 | 47 | 32 | 51 | 35 | 61 | 43 | .547 |
| 22 | 30 | 19 | 33 | 21 | 34 | 21 | 36 | 23 | 38 | 25 | 41 | 27 | 45 | 29 | 49 | 32 | 58 | 40 | .601 |
| 23 | 29 | ... | 31 | ... | 32 | ... | 34 | ... | 36 | 22 | 39 | 24 | 43 | 27 | 47 | 30 | 56 | 37 | .651 |
| 24 | 28 | ... | 30 | ... | 31 | ... | 33 | ... | 35 | ... | 38 | ... | 41 | ... | 45 | ... | 53 | 34 | .715 |
| 25 | 27 | ... | 29 | ... | 30 | ... | 31 | ... | 33 | ... | 36 | ... | 40 | ... | 43 | ... | 51 | 31 | .776 |
| 26 | 25 | ... | 28 | ... | 28 | ... | 30 | ... | 32 | ... | 35 | ... | 38 | ... | 41 | ... | 49 | ... | .839 |
| 27 | 25 | ... | 27 | ... | 27 | ... | 29 | ... | 31 | ... | 34 | ... | 37 | ... | 40 | ... | 47 | ... | .905 |
| 28 | 24 | ... | 26 | ... | 26 | ... | 28 | ... | 30 | ... | 32 | ... | 35 | ... | 38 | ... | 46 | ... | .973 |
| 29 | 23 | ... | 25 | ... | 25 | ... | 27 | ... | 29 | ... | 31 | ... | 34 | ... | 37 | ... | 44 | .. | 1.040 |
| 30 | 22 | ... | 24 | ... | 25 | ... | 26 | ... | 28 | ... | 30 | ... | 33 | ... | 36 | ... | 43 | ... | 1.120 |

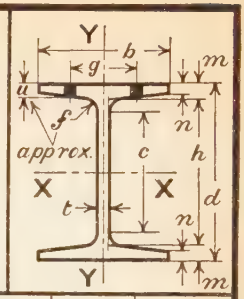
# 16″ B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



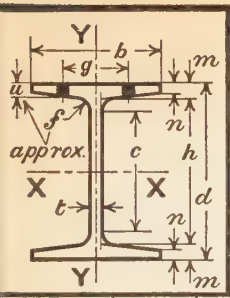

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | 15.81 | 16.00 | 16.12 | 16.25 | 15.88 | 16.00 | 16.12 | 16.25 | |
| Wt. per foot. | 35.0 | 40.0 | 45.0 | 50.0 | 56.5 | 60.5 | 66.0 | 71.5 | |
| Area, Sq. In.. | 10.29 | 11.83 | 13.26 | 14.78 | 16.63 | 17.89 | 19.40 | 21.07 | |
| b″..... | 7.240 | 7.250 | 7.285 | 7.320 | 8.485 | 8.500 | 8.530 | 8.565 | |
| t..... | .285 | .295 | .330 | .365 | .375 | .390 | .420 | .455 | |
| h..... | 14.704 | 14.704 | 14.704 | 14.704 | 14.248 | 14.248 | 14.248 | 14.248 | |
| m..... | .553 | .648 | .708 | .773 | .816 | .876 | .936 | 1.001 | |
| n..... | .263 | .358 | .418 | .483 | .479 | .539 | .599 | .664 | |
| f..... | .40 | .40 | .40 | .40 | .50 | .50 | .50 | .50 | |
| c..... | 14.000 | 14.000 | 14.000 | 14.000 | 13.375 | 13.375 | 13.375 | 13.375 | |
| g..... | 3¾ | 3¾ | 3¾ | 3¾ | 3¾ | 3¾ | 3¾ | 3¾ | |
| u..... | 13/32 | ½ | 9/16 | ⅝ | 11/16 | ¾ | 13/16 | ⅞ | |
| AXES X-X I.... | 435.8 | 526.2 | 594.5 | 669.0 | 742.3 | 812.1 | 888.4 | 973.5 | |
| AXES X-X S.... | 55.13 | 65.78 | 73.76 | 82.34 | 93.49 | 101.51 | 110.22 | 119.82 | |
| AXES X-X r.... | 6.51 | 6.67 | 6.69 | 6.73 | 6.68 | 6.74 | 6.77 | 6.80 | |
| AXES Y-Y I.... | 21.4 | 27.6 | 31.9 | 36.6 | 57.8 | 64.3 | 71.2 | 79.0 | |
| AXES Y-Y S.... | 5.92 | 7.61 | 8.75 | 10.01 | 13.6 | 15.1 | 16.7 | 18.4 | |
| AXES Y-Y r.... | 1.44 | 1.53 | 1.55 | 1.57 | 1.86 | 1.90 | 1.92 | 1.94 | |
| Coef. Str.... | 661500 | 789300 | 885100 | 988100 | 1121900 | 1218100 | 1322700 | 1437800 | |
| Max. Mom.″/# | 992300 | 1184000 | 1327700 | 1482100 | 1682800 | 1827200 | 1984000 | 2156700 | |
| V..... | 54100 | 56600 | 63800 | 71200 | 71500 | 74900 | 81200 | 88700 | |
| P, feet.. | 6.11 | 6.97 | 6.94 | 6.94 | 7.85 | 8.13 | 8.14 | 8.11 | |
| R..... | 25400 | 26700 | 31900 | 37100 | 39000 | 41100 | 45500 | 50600 | |
| W..... | 25700 | 25700 | 28800 | 32400 | 33800 | 35100 | 37800 | 41000 | |
| Q, feet.. | 12.87 | 15.36 | 15.37 | 15.25 | 16.60 | 17.35 | 17.50 | 17.53 | |
| w, lbs.. | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | |
| Rivet dia.. | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 108 | 108 | 113 | 113 | 128 | 128 | 142 | 142 | 143 | 143 | 150 | 150 | 162 | 162 | 177 | 177 | |
| 7 | 95 | 95 | 113 | 113 | 126 | 126 | 141 | 141 | 145 | 143 | 150 | 150 | 162 | 162 | 177 | 177 | |
| 8 | 83 | 83 | 99 | 99 | 111 | 111 | 124 | 124 | 140 | 140 | 150 | 150 | 162 | 162 | 177 | 177 | |
| 9 | 74 | 74 | 88 | 88 | 98 | 98 | 110 | 110 | 125 | 125 | 135 | 135 | 147 | 147 | 160 | 160 | |
| 10 | 66 | 65 | 79 | 77 | 89 | 87 | 99 | 97 | 112 | 112 | 122 | 122 | 132 | 132 | 144 | 144 | .116 |
| 11 | 60 | 57 | 72 | 69 | 81 | 77 | 90 | 86 | 102 | 101 | 111 | 110 | 120 | 119 | 131 | 130 | .141 |
| 12 | 55 | 51 | 66 | 61 | 74 | 69 | 82 | 76 | 94 | 91 | 102 | 99 | 110 | 107 | 120 | 117 | .168 |
| 13 | 51 | 46 | 61 | 55 | 68 | 61 | 76 | 69 | 86 | 82 | 94 | 89 | 102 | 97 | 111 | 106 | .197 |
| 14 | 47 | 41 | 56 | 49 | 63 | 55 | 71 | 62 | 80 | 74 | 87 | 81 | 95 | 88 | 103 | 96 | .228 |
| 15 | 44 | 37 | 53 | 45 | 59 | 50 | 66 | 56 | 75 | 68 | 81 | 74 | 88 | 80 | 96 | 87 | .262 |
| 16 | 41 | 34 | 49 | 40 | 55 | 45 | 62 | 51 | 70 | 62 | 76 | 67 | 83 | 74 | 90 | 80 | .298 |
| 17 | 39 | 31 | 46 | 37 | 52 | 42 | 58 | 46 | 66 | 57 | 72 | 62 | 78 | 67 | 85 | 74 | .336 |
| 18 | 37 | 28 | 44 | 34 | 49 | 38 | 55 | 43 | 62 | 52 | 68 | 57 | 74 | 62 | 80 | 67 | .377 |
| 19 | 35 | 26 | 42 | 31 | 47 | 35 | 52 | 39 | 59 | 48 | 64 | 52 | 70 | 57 | 76 | 62 | .420 |
| 20 | 33 | 24 | 40 | 29 | 44 | 32 | 49 | 35 | 56 | 44 | 61 | 48 | 66 | 53 | 72 | 57 | .466 |
| 21 | 32 | 22 | 38 | 26 | 42 | 29 | 47 | 33 | 53 | 41 | 58 | 45 | 63 | 49 | 69 | 54 | .513 |
| 22 | 30 | 20 | 36 | 24 | 40 | 27 | 45 | 30 | 51 | 38 | 55 | 41 | 60 | 45 | 65 | 49 | .563 |
| 23 | 29 | 19 | 34 | 22 | 39 | 25 | 43 | 28 | 49 | 36 | 53 | 39 | 58 | 42 | 63 | 46 | .616 |
| 24 | 28 | 17 | 33 | 21 | 37 | 23 | 41 | 26 | 47 | 33 | 51 | 36 | 55 | 39 | 60 | 43 | .670 |
| 25 | 27 | ... | 32 | ... | 35 | ... | 40 | ... | 45 | 31 | 49 | 34 | 53 | 36 | 58 | 40 | .727 |
| 26 | 25 | ... | 30 | ... | 34 | ... | 38 | .. | 43 | 29 | 47 | 31 | 51 | 34 | 55 | 37 | .787 |
| 27 | 25 | ... | 29 | ... | 33 | ... | 37 | ... | 42 | 27 | 45 | 29 | 49 | 32 | 53 | 34 | .848 |
| 28 | 24 | ... | 28 | ... | 32 | ... | 35 | ... | 40 | 25 | 44 | 27 | 47 | 29 | 51 | 32 | .912 |
| 29 | 23 | ... | 27 | ... | 31 | ... | 34 | .. | 39 | ... | 42 | ... | 46 | ... | 50 | ... | .979 |
| 30 | 22 | ... | 26 | ... | 30 | ... | 33 | .. | 37 | ... | 41 | ... | 44 | ... | 48 | ... | 1.047 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 18″ B

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 17.94 | 18.00 | 18.06 | 18.12 | 17.75 | 17.88 | 18.00 | 18.12 |
| Wt. per foot. | | 47.0 | 49.0 | 52.0 | 54.5 | 59.0 | 64.5 | 69.0 | 74.0 |
| Area. Sq. In.. | | 13.90 | 14.44 | 15.34 | 16.06 | 17.48 | 18.97 | 20.38 | 21.79 |
| b″..... | | 7.495 | 7.500 | 7.525 | 7.540 | 8.710 | 8.730 | 8.750 | 8.770 |
| t..... | | .325 | .330 | .355 | .370 | .380 | .400 | .420 | .440 |
| h..... | | 16.532 | 16.532 | 16.532 | 16.532 | 16.136 | 16.136 | 16.136 | 16.136 |
| m..... | | .704 | .734 | .764 | .794 | .807 | .872 | .932 | .992 |
| n..... | | .405 | .435 | .465 | .495 | .460 | .525 | .585 | .645 |
| f..... | | .40 | .40 | .40 | .40 | .50 | .50 | .50 | .50 |
| c..... | | 15.750 | 15.750 | 15.750 | 15.750 | 15.250 | 15.250 | 15.250 | 15.250 |
| g..... | | 3¾ | 3¾ | 3¾ | 3¾ | 4″ | 4″ | 4″ | 4″ |
| u..... | | 9/16 | 19/32 | 5/8 | 21/32 | 21/32 | 23/32 | 25/32 | 27/32 |
| AXES X-X | I.... | 764.1 | 802.8 | 851.7 | 896.1 | 960.3 | 1059.7 | 1153.7 | 1249.2 |
| | S.... | 85.18 | 89.20 | 94.32 | 98.91 | 108.20 | 118.53 | 128.19 | 137.88 |
| | r.... | 7.42 | 7.46 | 7.45 | 7.47 | 7.41 | 7.47 | 7.53 | 7.57 |
| AXES Y-Y | I.... | 34.0 | 36.1 | 38.7 | 41.1 | 60.7 | 68.4 | 75.6 | 82.9 |
| | S.... | 9.06 | 9.64 | 10.3 | 10.9 | 13.9 | 15.7 | 17.3 | 18.9 |
| | r.... | 1.56 | 1.58 | 1.59 | 1.60 | 1.86 | 1.90 | 1.93 | 1.95 |
| Coef. Str.... | | 1022200 | 1070400 | 1131800 | 1186900 | 1298400 | 1422400 | 1538300 | 1654600 |
| Max. Mom.″# | | 1533300 | 1605600 | 1697700 | 1780300 | 1947600 | 2133600 | 2307400 | 2481800 |
| V..... | | 70000 | 71300 | 76900 | 80500 | 80900 | 85800 | 90700 | 95700 |
| P. feet.. | | 7.30 | 7.51 | 7.36 | 7.37 | 8.02 | 8.29 | 8.48 | 8.64 |
| R..... | | 31000 | 31800 | 35800 | 38200 | 40200 | 43100 | 46300 | 49500 |
| W..... | | 36600 | 37100 | 39900 | 41600 | 42800 | 45000 | 47300 | 49500 |
| Q. feet.. | | 13.96 | 14.43 | 14.18 | 14 27 | 15.17 | 15.80 | 16.26 | 16.71 |
| w. lbs... | | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Rivet dia.... | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 140 | 140 | 143 | 143 | 154 | 154 | 161 | 161 | 162 | 162 | 172 | 172 | 181 | 181 | 191 | 191 | |
| 7 | 140 | 140 | 143 | 143 | 154 | 154 | 161 | 161 | 162 | 162 | 172 | 172 | 181 | 181 | 191 | 191 | |
| 8 | 128 | 128 | 134 | 134 | 141 | 141 | 148 | 148 | 162 | 162 | 172 | 172 | 181 | 181 | 191 | 191 | |
| 9 | 114 | 114 | 119 | 119 | 126 | 126 | 132 | 132 | 144 | 144 | 158 | 158 | 171 | 171 | 184 | 184 | .084 |
| 10 | 102 | 100 | 107 | 105 | 113 | 111 | 119 | 117 | 130 | 130 | 142 | 142 | 154 | 154 | 165 | 165 | .103 |
| 11 | 93 | 89 | 97 | 93 | 103 | 99 | 108 | 104 | 118 | 118 | 129 | 129 | 140 | 140 | 150 | 150 | .125 |
| 12 | 85 | 80 | 89 | 83 | 94 | 88 | 99 | 93 | 108 | 106 | 119 | 116 | 128 | 125 | 138 | 135 | .149 |
| 13 | 79 | 72 | 82 | 75 | 87 | 80 | 91 | 83 | 100 | 96 | 109 | 104 | 118 | 113 | 127 | 122 | .175 |
| 14 | 73 | 65 | 76 | 68 | 81 | 72 | 85 | 76 | 93 | 87 | 102 | 96 | 110 | 103 | 118 | 111 | .203 |
| 15 | 68 | 59 | 71 | 61 | 75 | 65 | 79 | 68 | 87 | 80 | 95 | 87 | 103 | 94 | 110 | 101 | .233 |
| 16 | 64 | 54 | 67 | 56 | 71 | 60 | 74 | 62 | 81 | 72 | 89 | 80 | 96 | 86 | 103 | 92 | .265 |
| 17 | 60 | 49 | 63 | 51 | 67 | 54 | 70 | 57 | 76 | 66 | 84 | 73 | 90 | 79 | 97 | 85 | .299 |
| 18 | 57 | 45 | 59 | 46 | 63 | 50 | 66 | 52 | 72 | 61 | 79 | 67 | 85 | 72 | 92 | 78 | .335 |
| 19 | 54 | 41 | 56 | 43 | 60 | 46 | 62 | 47 | 68 | 56 | 75 | 62 | 81 | 67 | 87 | 72 | .373 |
| 20 | 51 | 37 | 54 | 40 | 57 | 42 | 59 | 44 | 65 | 52 | 71 | 57 | 77 | 62 | 83 | 67 | .414 |
| 21 | 49 | 35 | 51 | 36 | 54 | 38 | 57 | 41 | 62 | 47 | 68 | 53 | 73 | 57 | 79 | 62 | .456 |
| 22 | 47 | 32 | 49 | 34 | 51 | 35 | 54 | 37 | 59 | 45 | 65 | 50 | 70 | 53 | 75 | 57 | .501 |
| 23 | 44 | 29 | 47 | 31 | 49 | 33 | 52 | 35 | 56 | 41 | 62 | 46 | 67 | 50 | 72 | 53 | .548 |
| 24 | 43 | 28 | 45 | 29 | 47 | 30 | 49 | 31 | 54 | 39 | 59 | 42 | 64 | 46 | 69 | 50 | .596 |
| 25 | 41 | ... | 43 | 27 | 45 | 28 | 47 | 29 | 52 | 36 | 57 | 40 | 62 | 43 | 66 | 46 | .647 |
| 26 | 39 | ... | 41 | ... | 44 | .. | 46 | ... | 50 | 34 | 55 | 37 | 59 | 40 | 64 | 44 | .699 |
| 27 | 38 | ... | 40 | ... | 42 | ... | 44 | ... | 48 | 32 | 53 | 35 | 57 | 38 | 61 | 40 | .754 |
| 28 | 37 | ... | 38 | ... | 40 | ... | 42 | ... | 46 | 29 | 51 | 33 | 55 | 35 | 59 | 38 | .811 |
| 29 | 35 | ... | 37 | ... | 39 | ... | 41 | ... | 45 | 28 | 49 | 30 | 53 | 33 | 57 | 35 | .870 |
| 30 | 34 | ... | 36 | ... | 38 | ... | 40 | ... | 43 | ... | 47 | ... | 51 | ... | 55 | ... | .931 |
| 31 | 33 | ... | 35 | ... | 37 | ... | 38 | ... | 42 | ... | 46 | ... | 50 | ... | 53 | ... | .994 |
| 32 | 32 | ... | 33 | ... | 35 | ... | 37 | ... | 41 | ... | 44 | ... | 48 | ... | 52 | ... | 1.06 |
| 33 | 31 | ... | 32 | ... | 34 | ... | 36 | ... | 39 | ... | 43 | ... | 47 | ... | 50 | ... | 1.13 |
| 34 | 30 | ... | 31 | ... | 33 | ... | 35 | ... | 38 | ... | 42 | ... | 45 | ... | 49 | .. | 1.20 |
| 35 | 29 | ... | 31 | ... | 32 | ... | 34 | ... | 37 | ... | 41 | ... | 44 | ... | 47 | ... | 1.27 |

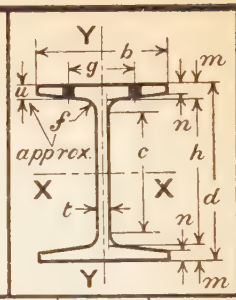
# 20" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth = d" | 19 88 | 20 00 | 20 06 | 20.12 | 19 88 | 20.00 | 20 09 | |
| Wt. per foot | 56 0 | 59.5 | 62 0 | 64 5 | 68 5 | 73.0 | 78.0 | |
| Area. Sq. In. | 16 51 | 17.47 | 18.25 | 18 93 | 20 12 | 21.58 | 22.98 | |
| b" | 8 000 | 8 000 | 8.015 | 8.025 | 8.855 | 8.875 | 8.905 | |
| t | .375 | .375 | .390 | .400 | 410 | .430 | .460 | |
| h | 18 392 | 18.392 | 18.392 | 18.392 | 18 136 | 18.136 | 18.136 | |
| m | .744 | .804 | 834 | .864 | .872 | .932 | .977 | |
| n | .425 | .485 | .515 | .545 | .520 | .580 | .625 | |
| f | .45 | .45 | .45 | .45 | .55 | .55 | .55 | |
| c | 17 625 | 17 625 | 17.625 | 17.625 | 17.125 | 17 125 | 17.125 | |
| g | 4" | 4" | 4" | 4" | 4" | 4" | 4" | |
| u | 19/32 | 21/32 | 11/16 | 23/32 | 23/32 | 25/32 | 27/32 | |
| AXES X-X I | 1086.1 | 1181.5 | 1239 8 | 1295.1 | 1366.0 | 1485 0 | 1585.5 | |
| AXES X-X S | 109.27 | 118.15 | 123 61 | 128 74 | 137.42 | 148 50 | 157.84 | |
| AXES X-X r | 8.11 | 8.22 | 8 24 | 8.27 | 8.24 | 8 30 | 8 31 | |
| AXES Y-Y I | 43 5 | 48.6 | 51 5 | 54 3 | 71.0 | 78.5 | 84.7 | |
| AXES Y-Y S | 10 9 | 12.2 | 12.9 | 13 5 | 16 0 | 17.7 | 19 0 | |
| AXES Y-Y r | 1 62 | 1.67 | 1 68 | 1 69 | 1.88 | 1 91 | 1 92 | |
| Coef. Str. | 1311200 | 1417800 | 1483300 | 1544800 | 1649100 | 1782000 | 1894100 | |
| Max.Mom."# | 1966800 | 2126700 | 2225000 | 2317300 | 2473600 | 2673000 | 2841100 | |
| V | 89500 | 90000 | 93900 | 96600 | 97800 | 103200 | 110900 | |
| P. feet | 7.33 | 7.88 | 7.90 | 8.00 | 8.43 | 8.63 | 8.54 | |
| R | 39100 | 38900 | 41500 | 43200 | 45100 | 48400 | 53500 | |
| W | 42200 | 42200 | 43900 | 45000 | 46200 | 48400 | 51800 | |
| Q. feet | 15.54 | 16 80 | 16 89 | 17 17 | 17 85 | 18 41 | 18 28 | |
| w. lbs. | 25 | 25 | 25 | 25 | 25 | 25 | 25 | |
| Rivet dia. | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | |

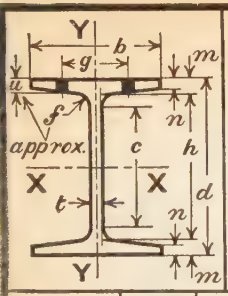
Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Total Deflection in inches for Maximum Load; Laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 179 | 179 | 180 | 180 | 188 | 188 | 193 | 193 | 196 | 196 | 206 | 206 | 222 | 222 | |
| 8 | 164 | 164 | 177 | 177 | 185 | 185 | 193 | 193 | 195 | 196 | 206 | 206 | 222 | 222 | |
| 10 | 131 | 131 | 142 | 142 | 148 | 148 | 154 | 154 | 165 | 165 | 178 | 178 | 189 | 189 | .093 |
| 11 | 119 | 116 | 129 | 126 | 135 | 132 | 140 | 137 | 150 | 150 | 162 | 162 | 172 | 172 | .113 |
| 12 | 109 | 104 | 118 | 113 | 124 | 119 | 129 | 124 | 137 | 134 | 149 | 146 | 158 | 155 | .134 |
| 13 | 101 | 94 | 109 | 102 | 114 | 106 | 119 | 111 | 127 | 122 | 137 | 132 | 146 | 141 | .158 |
| 14 | 94 | 86 | 101 | 92 | 106 | 97 | 110 | 100 | 118 | 111 | 127 | 120 | 135 | 127 | .183 |
| 15 | 87 | 77 | 95 | 84 | 99 | 88 | 103 | 91 | 110 | 101 | 119 | 110 | 126 | 116 | .210 |
| 16 | 82 | 71 | 89 | 77 | 93 | 80 | 97 | 84 | 103 | 93 | 111 | 100 | 118 | 106 | .239 |
| 17 | 77 | 65 | 83 | 70 | 87 | 73 | 91 | 76 | 97 | 85 | 105 | 92 | 111 | 98 | .270 |
| 18 | 73 | 59 | 79 | 64 | 82 | 67 | 86 | 70 | 92 | 79 | 99 | 85 | 105 | 90 | .302 |
| 19 | 69 | 55 | 75 | 59 | 78 | 62 | 81 | 64 | 87 | 73 | 94 | 79 | 100 | 84 | .336 |
| 20 | 66 | 51 | 71 | 54 | 74 | 57 | 77 | 59 | 83 | 67 | 89 | 72 | 95 | 78 | .373 |
| 21 | 62 | 46 | 68 | 50 | 71 | 53 | 74 | 55 | 79 | 62 | 85 | 67 | 90 | 71 | .411 |
| 22 | 60 | 43 | 64 | 46 | 67 | 48 | 70 | 50 | 75 | 58 | 81 | 62 | 86 | 66 | .451 |
| 23 | 57 | 40 | 62 | 43 | 64 | 45 | 67 | 47 | 72 | 54 | 77 | 58 | 82 | 62 | .493 |
| 24 | 55 | 37 | 59 | 40 | 62 | 42 | 64 | 43 | 69 | 50 | 74 | 54 | 79 | 58 | .537 |
| 25 | 52 | 34 | 57 | 37 | 59 | 39 | 62 | 41 | 66 | 47 | 71 | 50 | 76 | 54 | .582 |
| 26 | 50 | 32 | 55 | 35 | 57 | 36 | 59 | 37 | 63 | 43 | 69 | 47 | 73 | 50 | 630 |
| 27 | 49 | ... | 53 | ... | 55 | ... | 57 | .. | 61 | 41 | 66 | 44 | 70 | 47 | .679 |
| 28 | 47 | .. | 51 | ... | 53 | ... | 55 | .. | 59 | 38 | 64 | 41 | 68 | 44 | .736 |
| 29 | 45 | ... | 49 | .. | 51 | ... | 53 | ... | 57 | 36 | 61 | 38 | 65 | 41 | .783 |
| 30 | 44 | ... | 47 | .. | 49 | ... | 51 | ... | 55 | ... | 59 | ... | 63 | ... | .838 |
| 31 | 42 | ... | 46 | ... | 48 | ... | 50 | ... | 53 | .. | 57 | ... | 61 | ... | .895 |
| 32 | 41 | ... | 44 | ... | 46 | ... | 48 | ... | 52 | ... | 56 | .. | 59 | ... | .954 |
| 33 | 40 | ... | 43 | ... | 45 | ... | 47 | ... | 50 | ... | 54 | ... | 57 | ... | 1.01 |
| 34 | 39 | ... | 42 | ... | 44 | .. | 45 | ... | 49 | ... | 52 | ... | 56 | ... | 1.08 |
| 35 | 38 | ... | 41 | ... | 42 | ... | 44 | ... | 47 | ... | 51 | ... | 54 | ... | 1.14 |
| 36 | 36 | ... | 39 | ... | 41 | ... | 43 | ... | 46 | ... | 50 | ... | 53 | ... | 1.21 |
| 37 | 35 | ... | 38 | ... | 40 | ... | 42 | ... | 45 | ... | 48 | ... | 51 | ... | 1.28 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3 ½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets.
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 22″ B

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 21.75 | 21.88 | 22.00 | 22.12 | 22.25 | 21.88 | 22.00 | 22.12 | 22.25 | |
| Wt. per foot. | | 54 5 | 58 0 | 62.5 | 67.5 | 73.0 | 77.0 | 83.0 | 89.0 | 96.5 | |
| Area. Sq.In.. | | 16.04 | 17.14 | 18.38 | 19.84 | 21.51 | 22.74 | 24.51 | 26.28 | 28.38 | |
| b″..... | | 8.490 | 8.490 | 8.500 | 8.520 | 8.545 | 9.220 | 9.250 | 9.280 | 9.320 | |
| t..... | | .360 | .360 | .370 | .390 | .415 | .425 | .455 | .485 | .525 | |
| h..... | | 20.424 | 20.424 | 20.424 | 20.424 | 20.424 | 20.010 | 20.010 | 20.010 | 20.010 | |
| m..... | | .663 | .728 | .788 | .848 | .913 | .935 | .995 | 1.055 | 1.120 | |
| n..... | | .325 | .390 | .450 | .510 | .575 | .569 | .629 | .689 | .754 | |
| f..... | | .50 | .50 | .50 | 50 | .50 | .55 | .55 | .55 | .55 | |
| c..... | | 19.500 | 19.500 | 19.500 | 19.500 | 19.500 | 19.000 | 19 000 | 19.000 | 19.000 | |
| g..... | | 4″ | 4″ | 4″ | 4″ | 4″ | 4″ | 4″ | 4″ | 4″. | |
| u..... | | ½ | 9/16 | 5/8 | 11/16 | ¾ | 25/32 | 27/32 | 29/32 | 31/32 | |
| AXES X-X | I.... | 1232.6 | 1363.9 | 1495.4 | 1637.5 | 1796.7 | 1866.7 | 2026.5 | 2188.6 | 2373.7 | |
| | S.... | 113.34 | 124.67 | 135.95 | 148.06 | 161.50 | 170.63 | 184.23 | 197.88 | 213.37 | |
| | r.. | 8.77 | 8.92 | 9.02 | 9.08 | 9.14 | 9.06 | 9.09 | 9.13 | 9.15 | |
| AXES Y-Y | I.... | 42.2 | 48.9 | 55.2 | 61.8 | 69.1 | 87.0 | 95.8 | 104.8 | 115.1 | |
| | S.... | 9.95 | 11.5 | 13.0 | 14.5 | 16.2 | 18.9 | 20.7 | 22.6 | 24.7 | |
| | r.... | 1.62 | 1.69 | 1.73 | 1.76 | 1.79 | 1.96 | 1.98 | 2.00 | 2.01 | |
| Coef. Str.... | | 1360100 | 1496000 | 1631300 | 1776700 | 1938000 | 2047600 | 2210700 | 2374600 | 2560400 | |
| Max.Mom.″# | | 2040200 | 2244100 | 2447000 | 2665000 | 2907000 | 3071300 | 3316100 | 3561900 | 3840600 | |
| V..... | | 94000 | 94500 | 97700 | 103500 | 110800 | 111600 | 120100 | 128700 | 140200 | |
| P. feet.... | | 7.23 | 7.92 | 8.35 | 8.58 | 8.75 | 9.17 | 9.20 | 9.23 | 9.13 | |
| R..... | | 36000 | 36000 | 37700 | 41300 | 45800 | 47700 | 53000 | 58400 | 65400 | |
| W..... | | 48600 | 48600 | 49980 | 52680 | 56060 | 57400 | 61400 | 65500 | 70900 | |
| Q. feet... | | 13.99 | 15.39 | 16.32 | 16.86 | 17.29 | 17.84 | 18 00 | 18.13 | 18.06 | |
| w. lbs.... | | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | |
| Rivet dia.... | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 188 | 188 | 189 | 189 | 195 | 195 | 207 | 207 | 222 | 222 | 223 | 223 | 240 | 240 | 257 | 257 | 280 | 280 | |
| 8 | 170 | 170 | 187 | 187 | 195 | 195 | 207 | 207 | 222 | 222 | 223 | 223 | 240 | 240 | 257 | 257 | 280 | 280 | |
| 10 | 136 | 136 | 150 | 150 | 163 | 163 | 178 | 178 | 194 | 194 | 205 | 205 | 221 | 221 | 237 | 237 | 256 | 256 | .085 |
| 12 | 113 | 110 | 125 | 121 | 136 | 132 | 148 | 144 | 162 | 158 | 171 | 169 | 184 | 182 | 198 | 196 | 213 | 211 | .122 |
| 14 | 97 | 90 | 107 | 99 | 117 | 109 | 127 | 118 | 138 | 128 | 146 | 139 | 158 | 151 | 170 | 162 | 183 | 175 | .166 |
| 16 | 85 | 75 | 94 | 83 | 102 | 90 | 111 | 98 | 121 | 107 | 128 | 117 | 138 | 126 | 148 | 135 | 160 | 147 | .217 |
| 18 | 76 | 64 | 83 | 70 | 91 | 76 | 99 | 83 | 108 | 91 | 114 | 99 | 123 | 107 | 132 | 115 | 142 | 124 | .274 |
| 20 | 68 | 54 | 75 | 60 | 82 | 65 | 89 | 71 | 97 | 77 | 102 | 85 | 111 | 92 | 119 | 99 | 128 | 107 | .339 |
| 21 | 65 | 50 | 71 | 55 | 78 | 60 | 85 | 66 | 92 | 71 | 98 | 79 | 105 | 85 | 113 | 92 | 122 | 99 | .373 |
| 22 | 62 | 46 | 68 | 51 | 74 | 55 | 81 | 61 | 88 | 66 | 93 | 73 | 101 | 80 | 108 | 86 | 116 | 92 | .410 |
| 23 | 59 | 42 | 65 | 47 | 71 | 52 | 77 | 56 | 84 | 61 | 89 | 68 | 96 | 74 | 103 | 79 | 111 | 86 | .448 |
| 24 | 57 | 40 | 62 | 44 | 68 | 48 | 74 | 52 | 81 | 57 | 85 | 64 | 92 | 69 | 99 | 74 | 107 | 80 | .488 |
| 25 | 54 | 37 | 60 | 41 | 65 | 44 | 71 | 49 | 78 | 54 | 82 | 60 | 88 | 64 | 95 | 69 | 102 | 75 | .529 |
| 26 | 52 | 35 | 58 | 39 | 63 | 42 | 68 | 45 | 75 | 50 | 79 | 56 | 85 | 60 | 91 | 65 | 99 | 70 | .572 |
| 27 | 50 | 32 | 55 | 35 | 60 | 39 | 66 | 43 | 72 | 47 | 76 | 52 | 82 | 56 | 88 | 61 | 95 | 66 | .617 |
| 28 | 49 | 31 | 53 | 33 | 58 | 36 | 63 | 39 | 69 | 43 | 73 | 49 | 79 | 53 | 85 | 57 | 91 | 61 | 664 |
| 29 | 47 | ... | 52 | ... | 56 | .. | 61 | .. | 67 | .. | 71 | 46 | 76 | 49 | 82 | 53 | 88 | 58 | .712 |
| 30 | 45 | ... | 50 | .. | 54 | .. | 59 | .. | 65 | .. | 68 | 43 | 74 | 47 | 79 | 50 | 85 | 54 | 762 |
| 31 | 44 | .. | 48 | ... | 53 | ... | 57 | .... | 63 | .. | 66 | ... | 71 | ... | 77 | ... | 83 | 51 | 813 |
| 32 | 43 | ... | 47 | .. | 51 | ... | 56 | .... | 61 | .. | 64 | ... | 69 | ... | 74 | ... | 80 | .. | .867 |
| 33 | 41 | .. | 45 | .. | 49 | ... | 54 | .... | 59 | .. | 62 | ... | 67 | ... | 72 | ... | 78 | .. | .927 |
| 34 | 40 | ... | 44 | .. | 48 | ... | 52 | .... | 57 | .... | 60 | ... | 65 | ... | 70 | ... | 75 | .. | .979 |
| 35 | 39 | ... | 43 | .. | 47 | ... | 51 | .... | 55 | .... | 59 | ... | 63 | ... | 68 | ... | 73 | ... | 1.04 |
| 36 | 38 | ... | 42 | .. | 45 | ... | 49 | .... | 54 | .... | 57 | ... | 61 | ... | 66 | ... | 71 | ... | 1.10 |
| 38 | 36 | ... | 39 | .. | 43 | ... | 47 | .... | 51 | .... | 54 | ... | 58 | ... | 63 | ... | 67 | .. | 1.22 |
| 40 | 34 | ... | 37 | .. | 41 | ... | 44 | .... | 48 | .... | 51 | ... | 55 | ... | 59 | ... | 64 | .. | 1.35 |
| 42 | 32 | ... | 36 | .. | 39 | ... | 42 | .... | 46 | .... | 49 | ... | 53 | ... | 57 | ... | 61 | ... | 1.49 |
| 44 | 31 | ... | 34 | .. | 37 | ... | 40 | .... | 44 | .... | ... | ... | ... | ... | ... | ... | ... | ... | 1.64 |
| 46 | 30 | .. | 33 | ... | 35 | ... | 39 | .... | 42 | .... | ... | ... | ... | ... | ... | ... | ... | ... | 1.79 |

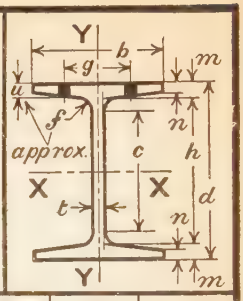
# 24" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



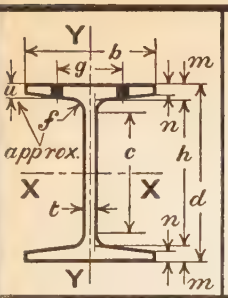

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d". | 23.88 | 24.00 | 24.09 | 24.00 | 24.12 | 23.91 | 24.00 | 24.09 |
| Wt. per foot. | 70.0 | 73.5 | 79.5 | 84.5 | 90 5 | 95.5 | 99.5 | 104 5 |
| Area. Sq. In.. | 20.62 | 21.70 | 23.35 | 24.97 | 26.47 | 28.05 | 29.40 | 30 88 |
| b".... | 9.000 | 9.000 | 9.035 | 9.500 | 9.515 | 9.730 | 9 750 | 9.775 |
| t.... | .395 | .395 | .430 | .460 | .475 | .505 | .525 | .550 |
| h.... | 22.242 | 22.242 | 22.242 | 22.106 | 22.106 | 21.822 | 21.822 | 21 822 |
| m.... | .819 | .879 | .924 | .947 | 1.007 | 1 044 | 1.089 | 1.134 |
| n.... | .460 | .520 | .565 | .570 | .630 | .650 | .705 | .750 |
| f.... | .50 | .50 | .50 | .55 | .55 | .60 | .60 | .60 |
| c.... | 21.375 | 21.375 | 21.375 | 21.125 | 21.125 | 20.750 | 20 750 | 20 750 |
| g.... | 4" | 4" | 4" | 4" | 4" | 5½ | 5½ | 5½ |
| u.... | 21/32 | 23/32 | 25/32 | 13/16 | 27/32 | 13/16 | 7/8 | 29/32 |
| AXES X-X I.... | 1954.1 | 2108.8 | 2266.7 | 2405.7 | 2588.2 | 2692.7 | 2841.3 | 2997.3 |
| AXES X-X S.... | 163.66 | 175.73 | 188.19 | 200.48 | 214.61 | 225.24 | 236.78 | 248.84 |
| AXES X-X r.... | 9.74 | 9.86 | 9.85 | 9.82 | 9.89 | 9.80 | 9.83 | 9.85 |
| AXES Y-Y I.... | 67.4 | 74.7 | 81.2 | 95.8 | 104.9 | 117.1 | 124.9 | 132.9 |
| AXES Y-Y S.... | 15.0 | 16.6 | 18.0 | 20.2 | 22.1 | 24.1 | 25.6 | 27.2 |
| AXES Y-Y r.... | 1.81 | 1.86 | 1.87 | 1.96 | 1.99 | 2.04 | 2.06 | 2.07 |
| Coef. Str.... | 1963900 | 2108800 | 2258200 | 2405700 | 2575300 | 2702800 | 2841300 | 2986100 |
| Max.Mom.*/* | 2945900 | 3163200 | 3387300 | 3608600 | 3863000 | 4054200 | 4262000 | 4479100 |
| V.... | 113200 | 113800 | 124300 | 132500 | 137500 | 144900 | 151200 | 159000 |
| P. feet.. | 8.67 | 9 27 | 9 08 | 9 08 | 9 36 | 9 33 | 9.40 | 9 39 |
| R.... | 42000 | 41800 | 48400 | 54100 | 56800 | 62700 | 66600 | 71400 |
| W.... | 53300 | 53300 | 58100 | 62100 | 64100 | 68200 | 70900 | 71600 |
| Q. feet.. | 18.42 | 19.78 | 19 43 | 19 37 | 20 09 | 19.82 | 20 04 | 20 85 |
| w. lbs... | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Rivet dia.... | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 226 | 226 | 228 | 228 | 249 | 249 | 265 | 265 | 275 | 275 | 290 | 290 | 302 | 302 | 318 | 318 | |
| 8 | 226 | 226 | 228 | 228 | 249 | 249 | 265 | 265 | 275 | 275 | 290 | 290 | 302 | 302 | 318 | 318 | |
| 10 | 196 | 196 | 211 | 211 | 226 | 226 | 241 | 241 | 258 | 258 | 270 | 270 | 284 | 284 | 299 | 299 | .078 |
| 12 | 164 | 162 | 176 | 173 | 188 | 185 | 201 | 200 | 215 | 214 | 225 | 225 | 237 | 237 | 249 | 249 | .112 |
| 14 | 140 | 132 | 151 | 143 | 161 | 152 | 172 | 165 | 184 | 177 | 193 | 187 | 203 | 197 | 213 | 206 | .152 |
| 16 | 123 | 111 | 132 | 120 | 141 | 128 | 150 | 138 | 161 | 149 | 169 | 157 | 178 | 166 | 187 | 174 | .199 |
| 18 | 109 | 94 | 117 | 101 | 125 | 108 | 134 | 118 | 143 | 126 | 150 | 134 | 158 | 141 | 166 | 148 | .251 |
| 20 | 98 | 80 | 105 | 86 | 113 | 93 | 120 | 101 | 129 | 109 | 135 | 115 | 142 | 121 | 149 | 127 | .310 |
| 21 | 94 | 75 | 100 | 80 | 108 | 86 | 114 | 94 | 123 | 101 | 129 | 107 | 135 | 113 | 142 | 118 | .342 |
| 22 | 89 | 69 | 96 | 75 | 103 | 80 | 109 | 87 | 117 | 94 | 123 | 100 | 129 | 105 | 136 | 111 | .375 |
| 23 | 85 | 64 | 92 | 69 | 98 | 74 | 105 | 82 | 112 | 88 | 117 | 93 | 124 | 98 | 130 | 103 | .411 |
| 24 | 82 | 60 | 88 | 65 | 94 | 69 | 100 | 76 | 107 | 82 | 113 | 87 | 118 | 91 | 124 | 96 | .447 |
| 25 | 79 | 56 | 84 | 60 | 90 | 64 | 96 | 71 | 103 | 76 | 108 | 81 | 114 | 86 | 119 | 90 | .485 |
| 26 | 76 | 53 | 81 | 56 | 87 | 61 | 93 | 67 | 99 | 72 | 104 | 76 | 109 | 80 | 115 | 85 | .525 |
| 27 | 73 | 49 | 78 | 53 | 84 | 57 | 89 | 63 | 95 | 67 | 100 | 71 | 105 | 75 | 111 | 80 | .566 |
| 28 | 70 | 46 | 75 | 49 | 81 | 53 | 86 | 59 | 92 | 63 | 97 | 68 | 101 | 70 | 107 | 75 | .608 |
| 29 | 68 | 43 | 73 | 46 | 78 | 50 | 83 | 55 | 89 | 59 | 93 | 63 | 98 | 67 | 103 | 70 | .653 |
| 30 | 66 | 41 | 70 | 43 | 75 | 47 | 80 | 52 | 86 | 56 | 90 | 59 | 95 | 63 | 100 | 66 | .698 |
| 31 | 63 | ... | 68 | ... | 73 | ... | 78 | 49 | 83 | 52 | 87 | 56 | 92 | 59 | 96 | 62 | .746 |
| 32 | 61 | ... | 66 | ... | 71 | ... | 75 | ... | 81 | ... | 84 | 52 | 89 | 56 | 93 | 58 | .795 |
| 33 | 60 | ... | 64 | ... | 68 | ... | 73 | ... | 78 | ... | 82 | ... | 86 | ... | 90 | ... | .845 |
| 34 | 58 | ... | 62 | ... | 66 | ... | 71 | ... | 76 | ... | 79 | ... | 84 | ... | 88 | ... | .897 |
| 35 | 56 | ... | 60 | ... | 65 | ... | 69 | ... | 74 | ... | 77 | ... | 81 | ... | 85 | ... | .950 |
| 36 | 55 | ... | 59 | ... | 63 | ... | 67 | ... | 72 | ... | 75 | ... | 79 | ... | 83 | ... | 1.01 |
| 38 | 52 | ... | 55 | ... | 59 | ... | 63 | ... | 68 | ... | 71 | ... | 75 | ... | 79 | ... | 1.12 |
| 40 | 49 | ... | 53 | ... | 56 | ... | 60 | ... | 64 | ... | 68 | ... | 71 | ... | 75 | ... | 1.24 |
| 42 | 47 | ... | 50 | ... | 54 | ... | 57 | ... | 61 | ... | 64 | ... | 68 | ... | 71 | ... | 1.37 |
| 44 | 45 | ... | 48 | ... | 51 | ... | 55 | ... | 59 | ... | 61 | ... | 65 | ... | 68 | ... | 1.50 |
| 46 | 43 | ... | 46 | ... | 49 | ... | 52 | ... | 56 | ... | 59 | ... | 62 | ... | 65 | ... | 1.64 |
| 48 | 41 | ... | 44 | ... | 47 | ... | 50 | ... | 54 | ... | 56 | ... | 59 | ... | 62 | ... | 1.79 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 26″ B

| | | | | | |
|---|---|---|---|---|---|
| Depth = d″. | | 25.78 | 25.88 | 26.00 | 26 12 |
| Wt. per foot. | | 81.0 | 85.5 | 91.0 | 98.0 |
| Area. Sq. In.. | | 23 90 | 25 11 | 26.76 | 28.69 |
| b″..... | | 9 470 | 9.480 | 9.500 | 9 530 |
| t..... | | .440 | 450 | .470 | .500 |
| h..... | | 24.036 | 24.036 | 24 036 | 24.036 |
| m..... | | .872 | .922 | .982 | 1.042 |
| n..... | | .495 | .545 | .605 | .665 |
| f..... | | .55 | .55 | .55 | .55 |
| c..... | | 23.00 | 23.00 | 23.00 | 23.00 |
| g..... | | 5½ | 5½ | 5½ | 5½ |
| u..... | | 21/32 | 11/16 | ¾ | 13/16 |
| AXES X-X | I.... | 2600.1 | 2772 5 | 2993 1 | 3231.2 |
| | S.... | 201.71 | 214.26 | 230.24 | 247 41 |
| | r.... | 10.43 | 10.51 | 10.58 | 10.61 |
| AXES Y-Y | I.... | 84.3 | 91 7 | 100 9 | 110.6 |
| | S.... | 17.8 | 19.3 | 21.2 | 23.2 |
| | r.... | 1.88 | 1 91 | 1 94 | 1.96 |
| Coef. Str.... | | 2420600 | 2571100 | 2762900 | 2968900 |
| Max. Mom. ″# | | 3630900 | 3856600 | 4144300 | 4453400 |
| V..... | | 136100 | 139700 | 146600 | 156800 |
| P. feet.. | | 8.89 | 9 20 | 9.42 | 9 47 |
| R..... | | 50400 | 52100 | 56000 | 62100 |
| W..... | | 69300 | 70900 | 74000 | 78800 |
| Q. feet.. | | 17.46 | 18 13 | 18 67 | 18.84 |
| w. lbs... | | 35 | 35 | 35 | 35 |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 242 | 242 | 257 | 257 | 276 | 276 | 297 | 297 | .072 |
| 12 | 202 | 201 | 214 | 213 | 230 | 229 | 247 | 246 | .103 |
| 14 | 173 | 166 | 184 | 177 | 197 | 189 | 212 | 204 | .140 |
| 16 | 151 | 139 | 161 | 148 | 173 | 160 | 186 | 172 | 183 |
| 18 | 135 | 119 | 143 | 126 | 153 | 135 | 165 | 146 | .232 |
| 20 | 121 | 102 | 129 | 109 | 138 | 116 | 148 | 125 | .287 |
| 21 | 115 | 94 | 122 | 100 | 132 | 109 | 141 | 116 | .316 |
| 22 | 110 | 88 | 117 | 94 | 126 | 101 | 135 | 108 | .347 |
| 23 | 105 | 82 | 112 | 87 | 120 | 94 | 129 | 101 | .379 |
| 24 | 101 | 77 | 107 | 81 | 115 | 88 | 124 | 95 | .413 |
| 25 | 97 | 72 | 103 | 76 | 110 | 82 | 119 | 88 | .448 |
| 26 | 93 | 67 | 99 | 71 | 106 | 77 | 114 | 83 | .484 |
| 27 | 90 | 63 | 95 | 67 | 102 | 72 | 110 | 77 | .522 |
| 28 | 87 | 59 | 92 | 63 | 99 | 68 | 106 | 73 | .562 |
| 29 | 84 | 56 | 89 | 59 | 95 | 63 | 102 | 68 | .602 |
| 30 | 81 | 52 | 86 | 55 | 92 | 59 | 99 | 64 | .645 |
| 31 | 78 | 49 | 83 | 52 | 89 | 56 | 96 | 61 | .688 |
| 32 | 76 | ... | 80 | .. | 86 | ... | 93 | ... | .733 |
| 33 | 73 | ... | 78 | ... | 84 | ... | 90 | ... | .780 |
| 34 | 71 | ... | 76 | ... | 81 | ... | 87 | ... | .832 |
| 35 | 69 | ... | 74 | ... | 79 | ... | 85 | ... | .877 |
| 36 | 67 | ... | 72 | ... | 77 | ... | 82 | ... | .928 |
| 38 | 64 | ... | 68 | .. | 73 | ... | 78 | ... | 1.03 |
| 40 | 61 | ... | 64 | .. | 69 | ... | 74 | ... | 1.15 |
| 42 | 58 | ... | 61 | ... | 66 | ... | 71 | ... | 1.26 |
| 44 | 55 | ... | 58 | ... | 63 | ... | 67 | ... | 1.39 |
| 46 | 53 | .. | 56 | ... | 60 | ... | 65 | ... | 1.52 |
| 48 | 50 | ... | 54 | .. | 58 | .. | 62 | ... | 1.65 |
| 50 | 48 | . | 51 | | 55 | ... | 59 | ... | 1.79 |

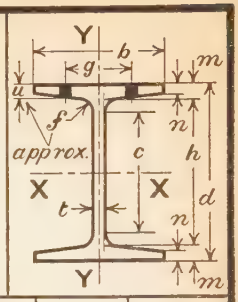
# 28" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3 ½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets.

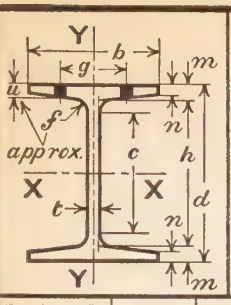
Rivet given is Maximum diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth = d". | 27.69 | 27.88 | 28 00 | 28.12 | 28.25 | 28.38 | 28 59 | Live Load deflection must not exceed 1/360 of the Span. |
| Wt. per foot. | 85.0 | 91.0 | 97.0 | 104 0 | 112 0 | 119.0 | 133 0 | |
| Area. Sq. In.. | 24.96 | 26 86 | 28 61 | 30 66 | 32.95 | 35.11 | 39 09 | |
| b". .... | 9 980 | 9.980 | 10.000 | 10 030 | 10 065 | 10.095 | 10.160 | |
| t ..... | .450 | .450 | 470 | 500 | 535 | .565 | 630 | |
| h..... | 26.008 | 26.008 | 26 008 | 26 008 | 26 008 | 26.008 | 26.008 | |
| m..... | .841 | .936 | 996 | 1 056 | 1 121 | 1.186 | 1 291 | |
| n..... | .444 | .539 | .599 | .659 | 724 | 789 | .894 | |
| f..... | .60 | .60 | .60 | 60 | .60 | .60 | 60 | |
| c .... | 24.875 | 24.875 | 24 875 | 24 875 | 24 875 | 24.875 | 24 875 | |
| g .... | 5 ½ | 5 ½ | 5 ½ | 5 ½ | 5 ½ | 5 ½ | 5 ½ | |
| u. | 5/8 | 23/32 | 25/32 | 27/32 | 29/32 | 31/32 | 1 1/32 | |
| AXES X-X I .. | 3075.2 | 3441.1 | 3711.5 | 4003.3 | 4328.0 | 4647.4 | 5204 0 | Live Load Def. = Total Def. × Live Load / Tabular Load |
| AXES X-X S .. | 222.12 | 246.85 | 265.11 | 284.73 | 306.41 | 327.51 | 364 04 | |
| AXES X-X r. . | 11.10 | 11.32 | 11.39 | 11.43 | 11.46 | 11.50 | 11 51 | |
| AXES Y-Y I ... | 91.0 | 106.7 | 117.4 | 128.7 | 141.2 | 153.7 | 175 3 | |
| AXES Y-Y S. .. | 18.2 | 21.4 | 23.5 | 25.7 | 28.1 | 30.5 | 34 5 | |
| AXES Y-Y r .. | 1.91 | 1.99 | 2.03 | 2.05 | 2.07 | 2.09 | 2 12 | |
| Coef. Str..... | 2665400 | 2962200 | 3181300 | 3416700 | 3676900 | 3930100 | 4368500 | |
| Max.Mom." # | 3998100 | 4443300 | 4771900 | 5125100 | 5515300 | 5895200 | 6552800 | |
| V..... | 149500 | 150600 | 157900 | 168700 | 181400 | 192400 | 216100 | |
| P. feet.. | 8 91 | 9.83 | 10 07 | 10 13 | 10 13 | 10.21 | 10 11 | |
| R ... | 51800 | 51700 | 55900 | 62100 | 69500 | 75900 | 89000 | |
| W | 81000 | 81000 | 84600 | 90000 | 95400 | 95400 | 95400 | |
| Q. feet . | 16 15 | 18 29 | 18 80 | 18 98 | 19 27 | 20 60 | 22 90 | |
| w. lbs... | 40 | 40 | 40 | 40 | 40 | 40 | 40 | |
| Rivet dia ... | 1" | 1" | 1" | 1" | 1" | 1" | 1" | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 267 | 267 | 296 | 296 | 316 | 316 | 337 | 337 | 363 | 363 | 385 | 385 | 432 | 432 | .066 |
| 12 | 222 | 222 | 247 | 247 | 265 | 265 | 285 | 285 | 306 | 306 | 328 | 328 | 364 | 364 | .096 |
| 14 | 190 | 185 | 212 | 206 | 227 | 221 | 244 | 238 | 263 | 256 | 281 | 274 | 312 | 305 | .123 |
| 16 | 167 | 157 | 185 | 174 | 199 | 187 | 214 | 201 | 230 | 216 | 246 | 232 | 273 | 257 | .170 |
| 18 | 148 | 133 | 165 | 149 | 177 | 159 | 190 | 171 | 204 | 184 | 218 | 197 | 243 | 220 | .215 |
| 20 | 133 | 115 | 148 | 128 | 159 | 137 | 171 | 148 | 184 | 159 | 197 | 171 | 219 | 190 | .266 |
| 21 | 127 | 107 | 141 | 119 | 151 | 127 | 163 | 138 | 175 | 148 | 187 | 158 | 208 | 177 | .293 |
| 22 | 121 | 99 | 135 | 111 | 145 | 119 | 155 | 128 | 167 | 138 | 179 | 148 | 199 | 165 | .322 |
| 23 | 116 | 93 | 129 | 104 | 138 | 111 | 149 | 120 | 160 | 129 | 171 | 138 | 190 | 154 | .352 |
| 24 | 111 | 87 | 123 | 96 | 133 | 104 | 142 | 112 | 153 | 121 | 164 | 130 | 182 | 144 | .383 |
| 25 | 107 | 82 | 118 | 90 | 127 | 97 | 137 | 105 | 147 | 113 | 157 | 121 | 175 | 135 | .416 |
| 26 | 103 | 77 | 114 | 85 | 122 | 91 | 131 | 98 | 141 | 106 | 151 | 114 | 168 | 127 | .450 |
| 27 | 99 | 72 | 110 | 80 | 118 | 86 | 127 | 93 | 136 | 100 | 146 | 107 | 162 | 119 | .485 |
| 28 | 95 | 67 | 106 | 75 | 114 | 81 | 122 | 87 | 131 | 93 | 140 | 100 | 156 | 112 | .521 |
| 29 | 92 | 64 | 102 | 70 | 110 | 76 | 118 | 82 | 127 | 88 | 136 | 95 | 151 | 106 | .559 |
| 30 | 89 | 60 | 99 | 67 | 106 | 71 | 114 | 77 | 123 | 83 | 131 | 89 | 146 | 100 | .599 |
| 31 | 86 | 56 | 96 | 63 | 103 | 68 | 110 | 72 | 119 | 78 | 127 | 84 | 141 | 94 | .639 |
| 32 | 83 | 53 | 93 | 59 | 99 | 63 | 107 | 69 | 115 | 74 | 123 | 79 | 137 | 89 | .681 |
| 33 | 81 | 50 | 90 | 56 | 96 | 60 | 104 | 65 | 111 | 70 | 119 | 75 | 132 | 83 | .724 |
| 34 | 78 | . | 87 | . | 94 | . . | 100 | . | 108 | .. | 116 | . . | 129 | . | .769 |
| 35 | 76 | .. | 85 | . | 91 | .. | 98 | .. | 105 | .. | 112 | . | 125 | . . | .815 |
| 36 | 74 | . | 82 | .. | 88 | ... | 95 | .. | 102 | ... | 109 | . | 121 | .. | .862 |
| 38 | 70 | . | 78 | . | 84 | . . | 90 | ... | 97 | ... | 103 | . | 115 | .. | .960 |
| 40 | 67 | . . | 74 | . . | 80 | . . | 85 | ... | 92 | ... | 98 | .. | 109 | .. | 1.06 |
| 42 | 64 | . | 71 | . | 76 | .. | 81 | .. | 88 | ... | 94 | .. | 104 | .. | 1.17 |
| 44 | 61 | . | 67 | .. | 72 | .. | 78 | ... | 84 | . . | 89 | .. | 99 | .. | 1.29 |
| 46 | 58 | | 64 | . | 69 | . | 74 | . | 80 | . | 85 | ... | 95 | .. | 1.40 |
| 48 | 56 | | 62 | .. | 66 | ... | 71 | . | 77 | . | 82 | . | 91 | .. | 1.53 |
| 50 | 53 | .. | 59 | . | 64 | . | 68 | .. | 74 | ... | 79 | .. | 87 | ... | 1.66 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 30″ B

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 29.78 | 29.88 | 30.00 | 30.12 | 30.25 | 30.44 | 30.65 | Live Load deflection must not exceed 1/360 of the Span. |
| Wt. per foot. | | 110.0 | 115.0 | 121.0 | 129.0 | 137.0 | 149.0 | 163.0 | |
| Area. Sq. In.. | | 32.45 | 33.80 | 35.65 | 37.82 | 40.40 | 43.93 | 48.00 | |
| b″..... | | 10.470 | 10.480 | 10.500 | 10.530 | 10.570 | 10.620 | 10.680 | |
| t..... | | .520 | .530 | .550 | .580 | .620 | .670 | .730 | |
| h..... | | 27.690 | 27.690 | 27.690 | 27.690 | 27.690 | 27.690 | 27.690 | |
| m..... | | 1.045 | 1.095 | 1.155 | 1.215 | 1.280 | 1.375 | 1.480 | |
| n..... | | .630 | .680 | .740 | .800 | .865 | .960 | 1.065 | |
| f..... | | .65 | .65 | .65 | .65 | .65 | .65 | .65 | |
| c..... | | 26 50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | |
| g..... | | 5½ | 5½ | 5½ | 5½ | 5 ½ | 5 ½ | 5 ½ | |
| u..... | | 27/32 | 7/8 | 15/16 | 1″ | 1 1/16 | 1 3/16 | 1 9/32 | |
| AXES X-X | I.... | 4687.7 | 4942.9 | 5269.7 | 5622.7 | 6026.7 | 6606.6 | 7270.7 | |
| | S.... | 314.82 | 330.85 | 351.31 | 373.35 | 398.46 | 434.07 | 474.43 | |
| | r.... | 12.02 | 12.09 | 12.16 | 12.19 | 12.21 | 12.26 | 12.31 | |
| AXES Y-Y | I.... | 141.8 | 151.8 | 164.3 | 177.6 | 192.6 | 214.5 | 239.8 | Live Load Def. = Total Def. × Live Load / Tabular Load |
| | S.... | 27.1 | 29.0 | 31.3 | 33.7 | 36.4 | 40.4 | 44.9 | |
| | r.... | 2.09 | 2.12 | 2.15 | 2.17 | 2.18 | 2.21 | 2.24 | |
| Coef. Str.... | | 3777900 | 3970200 | 4215800 | 4480200 | 4781500 | 5208900 | 5693200 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max. Mom.″# | | 5666800 | 5955300 | 6323600 | 6720400 | 7172300 | 7813300 | 8539800 | |
| V..... | | 185800 | 190000 | 198000 | 209700 | 225100 | 244700 | 268500 | |
| P. feet.. | | 10.17 | 10.45 | 10 65 | 10.68 | 10.62 | 10.64 | 10 60 | |
| R..... | | 66600 | 68400 | 72800 | 79400 | 88400 | 99700 | 113400 | |
| W..... | | 105300 | 107400 | 107400 | 107400 | 107400 | 107400 | 107400 | |
| Q. feet.. | | 17.94 | 18.48 | 19.63 | 20.86 | 22.26 | 24 25 | 26.50 | |
| w. lbs... | | 45 | 45 | 45 | 45 | 45 | 45 | 45 | |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

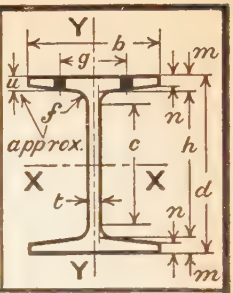
| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 315 | 315 | 331 | 331 | 351 | 351 | 373 | 373 | 398 | 398 | 434 | 434 | 474 | 474 | .089 |
| 14 | 270 | 266 | 284 | 280 | 301 | 296 | 320 | 315 | 342 | 337 | 372 | 367 | 407 | 403 | .122 |
| 16 | 236 | 225 | 248 | 236 | 263 | 250 | 280 | 267 | 299 | 285 | 326 | 311 | 356 | 340 | .159 |
| 18 | 210 | 192 | 221 | 203 | 234 | 214 | 249 | 229 | 266 | 245 | 289 | 266 | 316 | 292 | .201 |
| 20 | 189 | 166 | 198 | 174 | 211 | 186 | 224 | 198 | 239 | 211 | 261 | 231 | 285 | 253 | .248 |
| 21 | 180 | 155 | 189 | 163 | 201 | 173 | 213 | 184 | 228 | 197 | 248 | 215 | 271 | 236 | .274 |
| 22 | 172 | 145 | 180 | 152 | 192 | 162 | 204 | 172 | 217 | 184 | 237 | 201 | 259 | 221 | .300 |
| 23 | 164 | 135 | 173 | 143 | 183 | 151 | 195 | 161 | 208 | 172 | 227 | 189 | 248 | 207 | .329 |
| 24 | 157 | 127 | 165 | 133 | 176 | 142 | 187 | 151 | 199 | 161 | 217 | 176 | 237 | 193 | .358 |
| 25 | 151 | 119 | 159 | 125 | 169 | 133 | 179 | 141 | 191 | 151 | 208 | 165 | 228 | 182 | .388 |
| 26 | 145 | 112 | 153 | 118 | 162 | 125 | 172 | 133 | 184 | 142 | 200 | 155 | 219 | 171 | .420 |
| 27 | 140 | 105 | 147 | 111 | 156 | 117 | 166 | 125 | 177 | 134 | 193 | 146 | 211 | 161 | .452 |
| 28 | 135 | 99 | 142 | 104 | 151 | 111 | 160 | 118 | 171 | 126 | 186 | 138 | 203 | 151 | .487 |
| 29 | 130 | 93 | 137 | 98 | 145 | 104 | 154 | 111 | 165 | 119 | 180 | 130 | 196 | 142 | .522 |
| 30 | 126 | 88 | 132 | 92 | 141 | 99 | 149 | 104 | 159 | 112 | 174 | 123 | 190 | 135 | .559 |
| 31 | 122 | 83 | 128 | 87 | 136 | 93 | 144 | 99 | 154 | 106 | 168 | 116 | 184 | 127 | .596 |
| 32 | 118 | 78 | 124 | 83 | 132 | 88 | 140 | 93 | 149 | 100 | 163 | 110 | 178 | 120 | .636 |
| 33 | 115 | 75 | 120 | 78 | 128 | 83 | 136 | 89 | 145 | 95 | 158 | 104 | 173 | 114 | .676 |
| 34 | 111 | 70 | 117 | 74 | 124 | 78 | 132 | 84 | 141 | 90 | 153 | 98 | 167 | 107 | .718 |
| 35 | 108 | ... | 113 | ... | 120 | 74 | 128 | 79 | 137 | 85 | 149 | 93 | 163 | 102 | .760 |
| 36 | 105 | ... | 110 | ... | 117 | ... | 124 | ... | 133 | ... | 145 | ... | 158 | ... | .804 |
| 38 | 99 | ... | 104 | ... | 111 | ... | 118 | ... | 126 | ... | 137 | ... | 150 | ... | .896 |
| 40 | 95 | ... | 99 | ... | 105 | ... | 112 | ... | 120 | ... | 130 | ... | 142 | ... | .993 |
| 42 | 90 | ... | 95 | ... | 100 | ... | 107 | ... | 114 | ... | 124 | ... | 136 | ... | 1.10 |
| 44 | 86 | ... | 90 | ... | 96 | ... | 102 | ... | 109 | ... | 118 | ... | 129 | ... | 1.20 |
| 46 | 82 | ... | 86 | ... | 92 | ... | 97 | ... | 104 | ... | 113 | ... | 124 | ... | 1.31 |
| 48 | 79 | ... | 83 | ... | 88 | ... | 93 | ... | 100 | ... | 109 | ... | 119 | ... | 1.43 |
| 50 | 76 | ... | 79 | ... | 84 | ... | 90 | ... | 96 | ... | 104 | ... | 114 | ... | 1.55 |
| 52 | 73 | ... | 76 | ... | 81 | ... | 86 | ... | 92 | ... | 100 | ... | 109 | ... | 1.68 |
| 54 | 70 | ... | 74 | ... | 78 | ... | 83 | ... | 89 | ... | 96 | ... | 105 | ... | 1.81 |

# 33" B

## BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

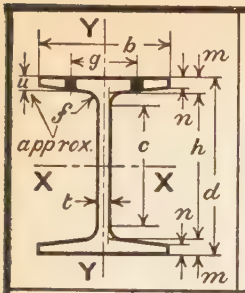
I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d". | | 32.89 | 33.00 | 33.12 | 33.27 | 33.50 | Live Load deflection must not exceed 1/360 of the Span. |
| Wt. per foot. | | 125.0 | 135.0 | 143.0 | 152.0 | 165.0 | |
| Area. Sq.In.. | | 36.83 | 39.55 | 42.05 | 44.65 | 48.52 | |
| b"..... | | 11.205 | 11.250 | 11.285 | 11.312 | 11.350 | |
| t..... | | .535 | .580 | .615 | .642 | .680 | |
| h..... | | 30.676 | 30.676 | 30.676 | 30.676 | 30.676 | |
| m..... | | 1.107 | 1.162 | 1.222 | 1.297 | 1.412 | |
| n..... | | .663 | .718 | .778 | .853 | .968 | |
| f..... | | .70 | .70 | .70 | .70 | .70 | |
| c..... | | 29.375 | 29.375 | 29.375 | 29.375 | 29.375 | |
| g..... | | 7½ | 7½ | 7½ | 7½ | 7½ | |
| u..... | | 13/16 | 7/8 | 15/16 | 1" | 1⅛ | |
| AXES X-X | I.... | 6498 2 | 6967.4 | 7442.2 | 7991.4 | 8835.4 | Live Load Def. = Total Def. × Live Load / Tabular Load |
| | S... | 395 15 | 422.27 | 449.41 | 480.40 | 527.49 | |
| | r... | 13 28 | 13 27 | 13 30 | 13 38 | 13 49 | |
| AXES Y-Y | I.... | 183 2 | 198 7 | 215 1 | 234 9 | 265 5 | |
| | S.... | 32 7 | 35 3 | 38 1 | 41 5 | 46 8 | |
| | r... | 2 23 | 2 24 | 2 26 | 2 29 | 2 34 | |
| Coef. Str.... | | 4741800 | 5067200 | 5392900 | 5764800 | 6329800 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max.Mom."# | | 7112700 | 7600800 | 8089300 | 8647100 | 9494800 | |
| V..... | | 211200 | 229700 | 244400 | 256300 | 273400 | |
| P. feet.... | | 11.23 | 11.03 | 11.03 | 11.25 | 11.58 | |
| R..... | | 69300 | 79700 | 87900 | 94300 | 103500 | |
| W..... | | 107370 | 107370 | 107370 | 107370 | 107370 | |
| Q. feet... | | 22.08 | 23.60 | 25.11 | 26.85 | 29.48 | |
| w. lbs ... | | 45 | 45 | 45 | 45 | 45 | |
| Rivet dia .. | | 1" | 1" | 1" | 1" | 1" | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span | Laterally | | Laterally | | Laterally | | Laterally | | Laterally | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| feet | fixed | free | fixed | free | fixed | free | fixed | free | fixed | free | |
| 12 | 395 | 395 | 422 | 422 | 449 | 449 | 480 | 480 | 527 | 527 | .081 |
| 14 | 339 | 338 | 362 | 362 | 385 | 385 | 412 | 411 | 452 | 451 | .111 |
| 16 | 296 | 287 | 317 | 307 | 337 | 327 | 360 | 349 | 396 | 384 | .144 |
| 18 | 263 | 236 | 282 | 265 | 300 | 282 | 320 | 301 | 352 | 331 | .183 |
| 20 | 237 | 214 | 253 | 229 | 270 | 245 | 288 | 261 | 317 | 288 | .226 |
| 21 | 226 | 200 | 241 | 214 | 257 | 229 | 275 | 245 | 301 | 268 | .249 |
| 22 | 216 | 188 | 230 | 200 | 245 | 214 | 262 | 229 | 288 | 252 | .273 |
| 23 | 206 | 174 | 220 | 188 | 235 | 201 | 251 | 215 | 275 | 236 | .298 |
| 24 | 198 | 164 | 211 | 177 | 225 | 189 | 240 | 201 | 264 | 222 | .325 |
| 25 | 190 | 154 | 203 | 166 | 216 | 177 | 231 | 188 | 253 | 208 | .353 |
| 26 | 182 | 145 | 195 | 157 | 207 | 166 | 222 | 177 | 244 | 197 | .381 |
| 27 | 176 | 138 | 188 | 148 | 200 | 157 | 214 | 167 | 234 | 185 | .411 |
| 28 | 169 | 129 | 181 | 139 | 193 | 149 | 206 | 158 | 226 | 175 | .442 |
| 29 | 164 | 123 | 175 | 132 | 186 | 140 | 199 | 149 | 218 | 165 | .475 |
| 30 | 158 | 116 | 169 | 124 | 180 | 133 | 192 | 141 | 211 | 155 | .508 |
| 31 | 153 | 110 | 164 | 118 | 174 | 125 | 186 | 134 | 204 | 146 | .542 |
| 32 | 148 | 104 | 158 | 111 | 169 | 119 | 180 | 127 | 198 | 139 | .578 |
| 33 | 144 | 99 | 154 | 106 | 163 | 112 | 175 | 121 | 192 | 132 | .614 |
| 34 | 140 | 94 | 149 | 100 | 159 | 107 | 170 | 115 | 186 | 125 | .652 |
| 35 | 136 | 89 | 145 | 95 | 154 | 101 | 165 | 109 | 181 | 119 | .691 |
| 36 | 132 | 84 | 141 | 90 | 150 | 96 | 160 | 103 | 176 | 113 | .731 |
| 38 | 125 | .. | 133 | .. | 142 | .. | 152 | .. | 167 | .. | .815 |
| 40 | 119 | .. | 127 | .. | 135 | .. | 144 | .. | 158 | .. | .903 |
| 42 | 113 | .. | 121 | .. | 128 | .. | 137 | .. | 151 | .. | .995 |
| 44 | 108 | .. | 115 | .. | 123 | .. | 131 | .. | 144 | .. | 1.09 |
| 46 | 103 | .. | 110 | .. | 117 | .. | 125 | .. | 138 | .. | 1.19 |
| 48 | 99 | .. | 106 | .. | 112 | .. | 120 | .. | 132 | .. | 1.30 |
| 50 | 95 | .. | 101 | .. | 108 | .. | 115 | .. | 127 | .. | 1.41 |
| 52 | 91 | .. | 97 | .. | 104 | .. | 111 | .. | 122 | .. | 1.53 |
| 54 | 88 | .. | 94 | .. | 100 | .. | 107 | .. | 117 | .. | 1.65 |




# BETHLEHEM BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus

r is Radius of Gyration

V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 36" B

| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d". | | 35.9 | 36.00 | 36.12 | 36.25 | 36.52 |
| Wt. per foot. | | 147.0 | 155.0 | 164.0 | 173.0 | 190.0 |
| Area. Sq.In.. | | 43.23 | 45.58 | 48.10 | 50.94 | 55.87 |
| b"..... | | 11.968 | 12.000 | 12.030 | 12.065 | 12.111 |
| t..... | | .583 | .615 | .645 | .680 | .726 |
| h..... | | 33.502 | 33.502 | 33.502 | 33.502 | 33.502 |
| m..... | | 1.199 | 1.249 | 1.309 | 1.374 | 1.509 |
| n..... | | .725 | .775 | .835 | .900 | 1.035 |
| f..... | | .75 | .75 | .75 | .75 | .75 |
| c..... | | 32.125 | 32.125 | 32.125 | 32.125 | 32.125 |
| g..... | | 7½ | 7½ | 7½ | 7½ | 7½ |
| u..... | | 29/32 | 31/32 | 1 1/32 | 1 3/32 | 1 7/32 |
| AXES X-X | I.... | 9036.3 | 9547.4 | 10133. | 10784. | 12049. |
| | S.... | 503.42 | 530.41 | 561.07 | 594.98 | 659 86 |
| | r.... | 14.46 | 14.47 | 14.51 | 14.55 | 14 68 |
| AXES Y-Y | I.... | 243.3 | 259.9 | 279.4 | 301.1 | 344.9 |
| | S.... | 40.7 | 43. | 46. | 49. | 57.0 |
| | r.... | 2.37 | 2.39 | 2.41 | 2 43 | 2 48 |
| Coef. Str.... | | 6041000 | 6364900 | 6732900 | 7139800 | 7918300 |
| Max.Mom."s | | 9061500 | 9547400 | 10099300 | 10709600 | 11877400 |
| V..... | | 251200 | 265700 | 279600 | 295800 | 318200 |
| P. feet.... | | 12 02 | 11.98 | 12 04 | 12.07 | 12 44 |
| R..... | | 80200 | 88100 | 95500 | 104300 | 116100 |
| W..... | | 107370 | 107370 | 107370 | 107370 | 107370 |
| Q. feet... | | 28.13 | 29 64 | 31 35 | 33.25 | 36.87 |
| w. lbs.... | | 45 | 45 | 45 | 45 | 45 |
| Rivet dia.... | | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = (Total Def. × Live Load) / Tabular Load

Total Deflection in inches for Maximum Load; Laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 502 | 502 | 530 | 530 | 559 | 559 | 592 | 592 | 636 | 636 | .074 |
| 14 | 432 | 432 | 455 | 455 | 481 | 481 | 510 | 510 | 566 | 566 | .101 |
| 16 | 378 | 372 | 398 | 392 | 421 | 415 | 446 | 440 | 495 | 488 | .132 |
| 18 | 336 | 321 | 354 | 333 | 374 | 358 | 397 | 380 | 440 | 421 | .167 |
| 20 | 302 | 279 | 318 | 294 | 337 | 312 | 357 | 331 | 396 | 367 | .207 |
| 21 | 288 | 262 | 303 | 276 | 321 | 293 | 340 | 310 | 377 | 343 | .228 |
| 22 | 275 | 246 | 289 | 258 | 306 | 274 | 325 | 291 | 360 | 323 | .250 |
| 23 | 263 | 231 | 277 | 243 | 293 | 258 | 310 | 273 | 344 | 302 | .273 |
| 24 | 252 | 217 | 265 | 229 | 281 | 243 | 297 | 257 | 330 | 284 | .298 |
| 25 | 242 | 204 | 255 | 216 | 269 | 228 | 286 | 243 | 317 | 268 | .323 |
| 26 | 232 | 192 | 245 | 203 | 259 | 216 | 275 | 229 | 305 | 253 | .350 |
| 27 | 224 | 182 | 236 | 192 | 249 | 203 | 264 | 215 | 293 | 238 | .377 |
| 28 | 216 | 172 | 227 | 181 | 240 | 192 | 255 | 204 | 283 | 226 | .406 |
| 29 | 208 | 162 | 219 | 171 | 232 | 182 | 246 | 193 | 273 | 214 | .435 |
| 30 | 201 | 154 | 212 | 162 | 224 | 172 | 238 | 183 | 264 | 202 | .466 |
| 31 | 195 | 146 | 205 | 154 | 217 | 163 | 230 | 173 | 255 | 191 | .497 |
| 32 | 189 | 139 | 199 | 146 | 210 | 155 | 223 | 164 | 247 | 181 | .530 |
| 33 | 183 | 131 | 193 | 139 | 204 | 147 | 216 | 156 | 240 | 172 | .563 |
| 34 | 178 | 125 | 187 | 132 | 198 | 140 | 210 | 148 | 233 | 164 | .598 |
| 35 | 173 | 119 | 182 | 125 | 192 | 133 | 204 | 141 | 226 | 155 | .634 |
| 36 | 168 | 113 | 177 | 119 | 187 | 126 | 198 | 134 | 220 | 148 | .670 |
| 38 | 159 | 102 | 167 | 108 | 177 | 115 | 188 | 122 | 208 | 134 | .747 |
| 40 | 151 | ... | 159 | ... | 168 | 104 | 178 | 110 | 198 | 122 | .828 |
| 42 | 144 | ... | 152 | ... | 160 | ... | 170 | ... | 189 | ... | .912 |
| 44 | 137 | ... | 145 | ... | 153 | ... | 162 | ... | 180 | ... | 1.001 |
| 46 | 131 | ... | 138 | ... | 146 | ... | 155 | ... | 172 | ... | 1.094 |
| 48 | 126 | ... | 133 | ... | 140 | ... | 149 | ... | 165 | ... | 1.191 |
| 50 | 121 | ... | 127 | ... | 135 | ... | 143 | ... | 158 | ... | 1.293 |
| 52 | 116 | ... | 122 | ... | 129 | ... | 137 | ... | 152 | ... | 1.399 |
| 54 | 112 | ... | 118 | ... | 125 | ... | 132 | ... | 147 | ... | 1.508 |

# ALLOWABLE END REACTIONS FOR BETHLEHEM BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per foot | Web t | Unit Stress in Buckling | Reaction R for 3½" Bearing | Min. Span for 3½" Bearing | Reaction R for 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V | Length of Bearing to develop V |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 17.5 | .250" | 15000 | 20600 | 4.19' | 24000 | 3750 | 24000 | 4.40" |
| | 19.0 | .270 | 15000 | 22300 | 4.25 | 26100 | 4050 | 26100 | 4.44 |
| 9 | 20.5 | .250 | 14800 | 21300 | 5.41 | 27000 | 3700 | 27000 | 5.05 |
| | 22.0 | .260 | 15000 | 22400 | 5.54 | 28300 | 3900 | 28300 | 5.01 |
| 10 | 21.0 | .240 | 14030 | 20200 | 6.49 | 27000 | 3370 | 28500 | 5.96 |
| | 23.5 | .250 | 14210 | 21300 | 6.93 | 28400 | 3550 | 30000 | 5.94 |
| | 26.0 | .270 | 14660 | 23700 | 6.91 | 31700 | 3960 | 32700 | 5.76 |
| | 28.5 | .285 | 14840 | 25400 | 7.15 | 33800 | 4230 | 34800 | 5.73 |
| 12 | 25.0 | .240 | 12780 | 19900 | 9.39 | 26000 | 3070 | 34200 | 8.17 |
| | 28.0 | .245 | 12860 | 20500 | 10.42 | 26800 | 3150 | 35300 | 8.21 |
| | 31.5 | .270 | 13470 | 23800 | 10.22 | 31000 | 3640 | 39300 | 7.77 |
| | 36.0 | .300 | 14090 | 27800 | 9.93 | 36200 | 4230 | 44100 | 7.36 |
| | 40.0 | .330 | 14750 | 31700 | 9.50 | 41400 | 4870 | 47500 | 6.75 |
| | 44.0 | .360 | 15000 | 35300 | 9.40 | 46100 | 5400 | 52400 | 6.67 |
| | 48.5 | .395 | 15000 | 38900 | 9.40 | 50800 | 5930 | 58100 | 6.74 |
| 14 | 30.0 | .265 | 12350 | 22900 | 11.13 | 29400 | 3270 | 44100 | 9.99 |
| | 33.0 | .265 | 12290 | 22800 | 12.57 | 29300 | 3260 | 44500 | 10.15 |
| | 37.5 | .305 | 13260 | 28300 | 11.52 | 36400 | 4040 | 51700 | 9.30 |
| | 42.0 | .340 | 13920 | 33100 | 11.10 | 42600 | 4730 | 58100 | 8.78 |
| 15 | 36.0 | .280 | 12220 | 24800 | 13.34 | 31600 | 3420 | 50100 | 10.90 |
| | 38.5 | .290 | 12460 | 26200 | 13.67 | 33400 | 3610 | 52200 | 10.70 |
| | 40.0 | .305 | 12830 | 28400 | 13.01 | 36200 | 3910 | 55000 | 10.30 |
| | 42.5 | .325 | 13290 | 31300 | 12.50 | 40000 | 4320 | 58900 | 9.89 |
| | 46.0 | .365 | 14150 | 37400 | 11.06 | 47700 | 5160 | 64600 | 8.77 |
| | 50.5 | .385 | 14360 | 40100 | 11.33 | 51200 | 5530 | 68700 | 8 67 |
| | 54.5 | .410 | 14720 | 43800 | 11.27 | 55800 | 6040 | 73800 | 8.48 |
| | 59.5 | .450 | 15000 | 48900 | 10.97 | 62400 | 6750 | 81700 | 8.35 |
| | 71.5 | .520 | 15000 | 56600 | 11.30 | 72200 | 7800 | 93600 | 8.25 |
| 16 | 35.0 | .285 | 11900 | 25400 | 13.02 | 32200 | 3390 | 54100 | 11.96 |
| | 40.0 | .295 | 12080 | 26700 | 14.78 | 33800 | 3560 | 56600 | 11.90 |
| | 45.0 | .330 | 12880 | 31900 | 13.87 | 40400 | 4250 | 63800 | 11.01 |
| | 50.0 | .365 | 13530 | 37100 | 13.32 | 46900 | 4940 | 71200 | 10.41 |
| | 56.5 | .375 | 13860 | 39000 | 14.38 | 49400 | 5200 | 71500 | 9.75 |
| | 60.5 | .390 | 14060 | 41100 | 14.82 | 52100 | 5480 | 74900 | 9.67 |
| | 66.0 | .420 | 14450 | 45500 | 14.53 | 57700 | 6070 | 81200 | 9.38 |
| | 71.5 | .455 | 14840 | 50600 | 14.21 | 64100 | 6750 | 88700 | 9.14 |
| 18 | 47.0 | .325 | 11940 | 31000 | 16.49 | 38800 | 3880 | 70000 | 13.54 |
| | 49 0 | .330 | 12030 | 31800 | 16.83 | 39700 | 3970 | 71300 | 13.46 |
| | 52 0 | .355 | 12600 | 35800 | 15.80 | 44700 | 4470 | 76900 | 12.69 |
| | 54.5 | .370 | 12910 | 38200 | 15.53 | 47800 | 4780 | 80500 | 12.35 |
| | 59.0 | .380 | 13200 | 40200 | 16.15 | 50200 | 5020 | 80900 | 11.62 |
| | 64 5 | .400 | 13460 | 43100 | 16.50 | 53900 | 5390 | 85800 | 11.43 |
| | 69.0 | .420 | 13780 | 46300 | 16.61 | 57900 | 5790 | 90700 | 11.19 |
| | 74.0 | .440 | 14080 | 49500 | 16.63 | 61900 | 6190 | 95700 | 10.95 |

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

# ALLOWABLE END REACTIONS FOR BETHLEHEM BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

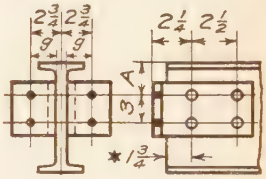
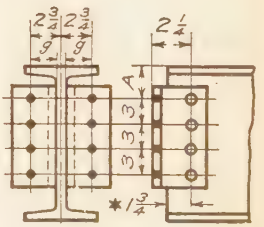
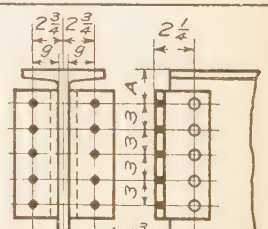
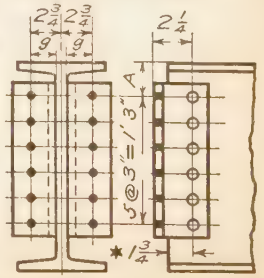
| Depth in Inches | Weight per foot | Web t | Unit Stress in Buckling | Reaction R for 3 ½" Bearing | Min. Span for 3 ½" Bearing | Reaction R for 5 ½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V | Length of Bearing to develop V |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 56.0 | .375" | 12260 | 39100 | 16 77 | 48300 | 4600 | 89500 | 14.46" |
| | 59.5 | .375 | 12210 | 38900 | 18.23 | 48100 | 4580 | 90000 | 14.66 |
| | 62.0 | .390 | 12520 | 41500 | 17.87 | 51300 | 4880 | 93900 | 14.23 |
| | 64.5 | .400 | 12710 | 43200 | 17.88 | 53400 | 5080 | 96600 | 14.00 |
| | 68.5 | .410 | 12930 | 45100 | 18.28 | 55700 | 5300 | 97800 | 13.45 |
| | 73.0 | .430 | 13230 | 48100 | 18.41 | 59700 | 5690 | 103200 | 13.14 |
| | 78.0 | .460 | 13690 | 53500 | 17.70 | 66100 | 6300 | 110900 | 12.61 |
| 22 | 54.5 | .360 | 11190 | 36000 | 18.88 | 44100 | 4030 | 94000 | 17.89 |
| | 58.0 | .360 | 11140 | 36000 | 20.78 | 44000 | 4010 | 94500 | 18.10 |
| | 62.5 | .370 | 11330 | 37700 | 21.64 | 46100 | 4190 | 97700 | 17.82 |
| | 67.5 | .390 | 11720 | 41300 | 21.51 | 50400 | 4570 | 103500 | 17.12 |
| | 73.0 | .415 | 12170 | 45800 | 21.16 | 55900 | 5050 | 110800 | 16.38 |
| | 77.0 | .425 | 12480 | 47700 | 21.46 | 58300 | 5300 | 111600 | 15.56 |
| | 83.0 | .455 | 12950 | 53000 | 20.86 | 64800 | 5890 | 120100 | 14.89 |
| | 89.0 | .485 | 13370 | 58400 | 20.33 | 71300 | 6480 | 128700 | 14.36 |
| | 96.5 | .525 | 13850 | 65400 | 19.58 | 80000 | 7270 | 140200 | 13.78 |
| 24 | 70.0 | .395 | 11190 | 42000 | 23.38 | 50800 | 4420 | 113200 | 19.61 |
| | 73.5 | .395 | 11150 | 41800 | 25.22 | 50600 | 4400 | 113800 | 19.85 |
| | 79.5 | .430 | 11850 | 48400 | 23.33 | 58600 | 5090 | 124300 | 18.40 |
| | 84.5 | .460 | 12380 | 54100 | 22.24 | 65500 | 5700 | 132500 | 17.26 |
| | 90.5 | .475 | 12590 | 56800 | 22.67 | 68800 | 5980 | 137500 | 16.99 |
| | 95.5 | .505 | 13080 | 62700 | 21.55 | 73000 | 6600 | 144900 | 15.94 |
| | 99.5 | .525 | 13350 | 66600 | 21.33 | 80600 | 7010 | 151200 | 15.57 |
| | 104.5 | .550 | 13660 | 71400 | 20.91 | 86400 | 7510 | 159000 | 15.16 |
| 26 | 81.0 | .440 | 11450 | 50400 | 24.01 | 60500 | 5040 | 136100 | 20.50 |
| | 85.5 | .450 | 11570 | 52100 | 24.68 | 62500 | 5210 | 139700 | 20.33 |
| | 91.0 | .470 | 11920 | 56000 | 24.66 | 67200 | 5600 | 146600 | 19.66 |
| | 98.0 | .500 | 12410 | 62100 | 23.90 | 74500 | 6210 | 156800 | 18.77 |
| 28 | 85.0 | .450 | 11040 | 51800 | 25.75 | 61700 | 4970 | 149500 | 23.18 |
| | 91.0 | .450 | 10980 | 51700 | 28.65 | 61600 | 4940 | 150600 | 23.52 |
| | 97.0 | .470 | 11310 | 55900 | 28 46 | 66500 | 5320 | 157900 | 22.68 |
| | 104.0 | .500 | 11790 | 62100 | 27.51 | 73900 | 5900 | 168700 | 21.56 |
| | 112.0 | .535 | 12290 | 69500 | 26.45 | 82700 | 6580 | 181400 | 20 51 |
| | 119.0 | .565 | 12670 | 75900 | 25.91 | 90200 | 7160 | 192400 | 19.78 |
| | 133.0 | .630 | 13400 | 89900 | 24.30 | 106800 | 8440 | 216100 | 18.45 |
| 30 | 110.0 | .520 | 11640 | 66600 | 28 36 | 78700 | 6050 | 185800 | 23.21 |
| | 115.0 | .530 | 11740 | 68400 | 29.02 | 80900 | 6220 | 190000 | 23.05 |
| | 121.0 | .550 | 12040 | 72800 | 28.95 | 86000 | 6620 | 198000 | 22.41 |
| | 129.0 | .580 | 12450 | 79400 | 28 21 | 93900 | 7220 | 209700 | 21.54 |
| | 137 0 | 620 | 12890 | 88400 | 27.05 | 104400 | 7990 | 225100 | 20.61 |
| | 149 0 | .670 | 13390 | 99700 | 26.13 | 117600 | 8970 | 244700 | 19.66 |
| | 163.0 | .730 | 13910 | 113400 | 25 11 | 133700 | 10160 | 268500 | 18.78 |
| 33 | 125.0 | .535 | 11040 | 69300 | 34.23 | 81100 | 5910 | 211200 | 27.51 |
| | 135.0 | .580 | 11690 | 79700 | 31.79 | 93200 | 6780 | 229700 | 25.63 |
| | 143.0 | .615 | 12130 | 87900 | 30 68 | 102800 | 7460 | 244400 | 24.48 |
| | 152.0 | .642 | 12430 | 94300 | 30 55 | 110300 | 7980 | 256300 | 23.80 |
| | 165.0 | .680 | 12820 | 103500 | 30.59 | 120900 | 8710 | 273400 | 23.01 |
| 36 | 147.0 | .583 | 11030 | 80200 | 37.66 | 93100 | 6430 | 251200 | 30 09 |
| | 155 0 | 615 | 11460 | 88100 | 36 12 | 102200 | 7050 | 265700 | 28.69 |
| | 164.0 | .645 | 11820 | 95500 | 35 25 | 110700 | 7620 | 279600 | 27.66 |
| | 173.0 | .680 | 12210 | 104300 | 34.23 | 120900 | 8300 | 295800 | 26.58 |
| | 190.0 | .726 | 12660 | 116100 | 34 11 | 134500 | 9190 | 318200 | 25.49 |

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

# CONNECTION ANGLES FOR BETHLEHEM BEAMS

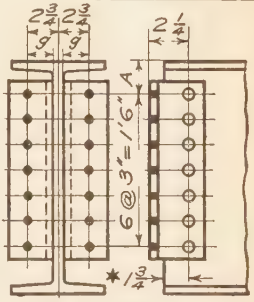
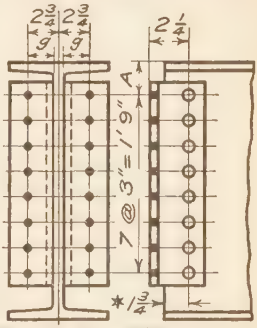
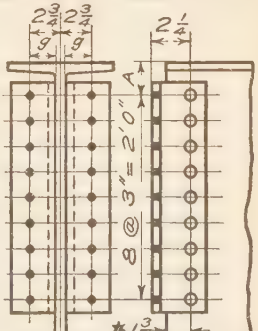
DIMENSIONS, WEIGHTS, AND WORKING LOADS — ¾″ POWER DRIVEN RIVETS

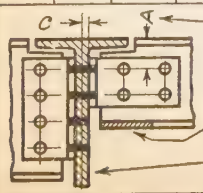
| Beam Depth | Beam Weight per foot | Connection Value: Outstanding Single Shear: Web | Connection Value: Outstanding Single Shear: Power Driven Rivets | Connection Value: Outstanding Single Shear: Unfinished Bolts | Framing Distance c | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Connection Angles: Weight inc. Web Rivets | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| 8″ | 17.5 | 22500 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 19.0 | 24300 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| 9″ | 20.5 | 22500 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 22.0 | 23400 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 21.0 | 21600 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| 10″ | 23.5 | 22500 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 26.0 | 24300 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 28.5 | 24460 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | 6″ × 4″ × 3/8″ | 13 |  |
| | 25.0 | 21600 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | 0′ — 5½″ Long | lbs. | |
| | 28.0 | 22050 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| 12″ | 31.5 | 24300 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 36.0 | 27000 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 40.0 | 29700 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 44.0 | 32400 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 48.5 | 35570 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| 14″ | 30.0 | 23850 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 33.0 | 23850 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 37.5 | 27450 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 42.0 | 30600 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 36.0 | 25200 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 38.5 | 26100 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 40.0 | 27450 | 47720 | 35340 | 1/4 | IC.19.10 | 2 5/8 | | | |
| 15″ | 42.5 | 29250 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 46.0 | 32850 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 50.5 | 34650 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 54.5 | 36900 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 59.5 | 40500 | 47720 | 35340 | 5/16 | IC.19. 8 | 2 ½ | 4″ × 3½″ × 3/8″ | 19 |  |
| | 71.5 | 46800 | 47720 | 35340 | 5/16 | IC.19. 8 | 2 ½ | 0′ — 11½″ Long | lbs. | |
| | 35.0 | 25650 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 40.0 | 25650 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 45.0 | 28800 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| 16″ | 50.0 | 32400 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 56.5 | 33750 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 60.5 | 35100 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 66.0 | 37800 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 71.5 | 40960 | 47720 | 35340 | 5/16 | IC.19. 8 | 2 ½ | | | |
| | 47.0 | 36580 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 49.0 | 37130 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 52.0 | 39940 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| 18″ | 54.5 | 41630 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 59.0 | 42750 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 64.5 | 45000 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 69.0 | 47250 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 74.0 | 49500 | 59650 | 44180 | 5/16 | IC.25. 8 | 2 ½ | 4″ × 3½″ × 3/8″ | 25 |  |
| | 56.0 | 42200 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | lbs. | |
| | 59.5 | 42200 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | 1′ — 2½″ Long | | |
| | 62.0 | 43880 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 64.5 | 45000 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| 20″ | 68.5 | 46150 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 73.0 | 48380 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 78.0 | 51750 | 59650 | 44180 | 5/16 | IC.25. 8 | 2 ½ | | | |
| | 54.5 | 48600 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 58.0 | 48600 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 62.5 | 49980 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| 22″ | 67.5 | 52680 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 73.0 | 56060 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 77.0 | 57390 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 83.0 | 61440 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |
| | 89.0 | 65490 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |
| | 96.5 | 70890 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | 4″ × 3½″ × 3/8″ | 30 |  |
| | 70.0 | 53330 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | lbs. | |
| | 73.5 | 53330 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | 1′ — 5½″ Long | | |
| | 79.5 | 58050 | 71580 | 52020 | 5/16 | IC.30. 9 | 2 9/16 | | | |
| 24″ | 84.5 | 62100 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |
| | 90.5 | 64140 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |
| | 95.5 | 68180 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |
| | 99.5 | 70880 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |
| | 104.5 | 71580 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 ½ | | | |

LOADS BY A. I. S. C. SPECIFICATION

# CONNECTION ANGLES FOR BETHLEHEM BEAMS

DIMENSIONS, WEIGHTS AND WORKING LOADS — ¾" POWER DRIVEN RIVETS

| Beam | | Connection Value | | | Framing Distance | Connection Angles | | | | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Outstanding Single Shear | | | | | | | |
| Depth | Weight per foot | Web | Power Driven Rivets | Unfinished Bolts | C | A.I.S.C. Mark | Gage g | Size and Length | Weight inc. Web Rivets | |
| 26" | 81.0 | 69300 | 83510 | 61850 | 5/16 | IC.35. 8 | 2 1/2 | 4" × 3½" × ⅜" 1' — 8½" Long | 35 lbs. |  |
| | 85.5 | 70875 | 83510 | 61850 | 5/16 | IC.35. 8 | 2 1/2 | | | |
| | 91.0 | 74030 | 83510 | 61850 | 5/16 | IC.35. 8 | 2 1/2 | | | |
| | 98.0 | 78750 | 83510 | 61850 | 5/16 | IC.35. 8 | 2 1/2 | | | |
| 28" | 85.0 | 81040 | 95440 | 70690 | 5/16 | IC.40.8 | 2 1/2 | 4" × 3½" × ⅜" 1' — 11½" Long | 40 lbs. |  |
| | 91.0 | 81040 | 95440 | 70690 | 5/16 | IC.40.8 | 2 1/2 | | | |
| | 97.0 | 84640 | 95440 | 70690 | 5/16 | IC.40.8 | 2 1/2 | | | |
| | 104.0 | 90000 | 95440 | 70690 | 5/16 | IC.40.8 | 2 1/2 | | | |
| | 112.0 | 95440 | 95440 | 70690 | 5/16 | IC.40.8 | 2 1/2 | | | |
| | 119.0 | 95440 | 95440 | 70690 | ⅜ | IC.40.7 | 2 7/16 | | | |
| | 133.0 | 95440 | 95440 | 70690 | ⅜ | IC.40.7 | 2 7/16 | | | |
| 30" | 110.0 | 105300 | 107370 | 79530 | 5/16 | IC.45.8 | 2 1/2 | 4" × 3½" × ⅜" 2' — 2½" Long | 45 lbs. |  |
| | 115.0 | 107370 | 107370 | 79530 | 5/16 | IC.45.8 | 2 1/2 | | | |
| | 121.0 | 107370 | 107370 | 79530 | 5/16 | IC.45.8 | 2 1/2 | | | |
| | 129.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 137.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 149.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 163.0 | 107370 | 107370 | 79530 | 7/16 | IC.45.6 | 2 ⅜ | | | |
| 33" | 125.0 | 107370 | 107370 | 79530 | 5/16 | IC.45.8 | 2 1/2 | | | |
| | 135.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 143.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 152.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 165.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| 36" | 147.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 155.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 164.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 173.0 | 107370 | 107370 | 79530 | ⅜ | IC.45.7 | 2 7/16 | | | |
| | 190.0 | 107370 | 107370 | 79530 | 7/16 | IC.45.6 | 2 ⅜ | | | |




When A = 2¾" all beams up to and including 26" can be framed opposite with tops flush.

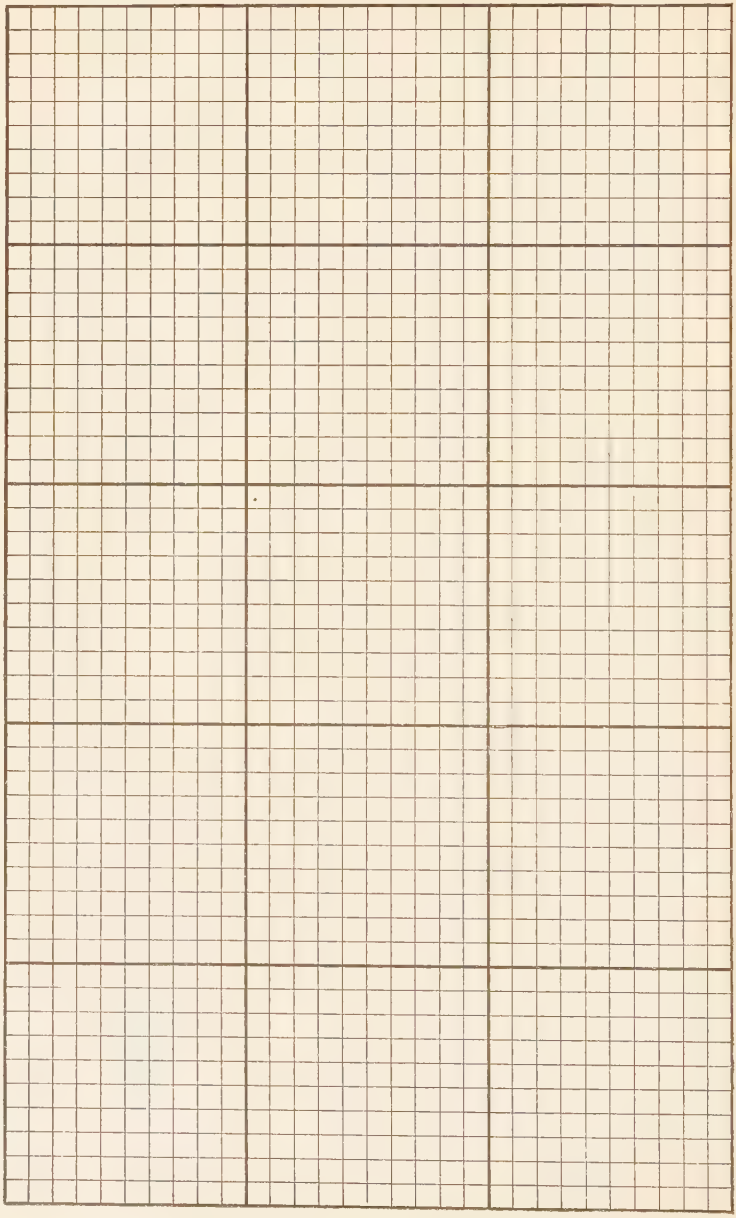
When A = 3" all beams except 14" can be framed opposite with tops flush.

Flange must be cut away as shown for field riveting on all beams framing opposite a larger beam, if flange interferes with outstanding rivets.

Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

LOADS BY A. I. S. C. SPECIFICATION

## NOTES and DIAGRAMS



# Part IV

# Section 6

## BETHLEHEM GIRDER BEAM SECTIONS

### Dimensions—Technical Functions

### Allowable Total Loads by A. I. S. C. Specification

### Allowable End Reactions—Standard Connection Angles

| Usual Stock Sizes | | | | | |
|---|---|---|---|---|---|
| Depth | Weight | Depth | Weight | Depth | Weight |
| 8″ | 33.0 * | 16″ | 81.0 * | 26″ | 151.0 * |
| 9″ | 38.5 * | 18″ | 86.0 * | 28″ | 165.0 * |
| 10″ | 44.5 * | 20″ | 113.0 * | 30″ | 180.0 * |
| 12″ | 55.5 * | 22″ | 108.0 * | 33″ | 210.0 * |
| 15″ | 74.0 * | 24″ | 120.0 * | 36″ | 240.0 * |

**Manufacturers Section Index**

| Sec. Index | Depth | Weight | | | | Sec. Index | Depth | Weight | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G 8 | 8″ | 29.5 | 33.0 | 36.5 | | G 20 | 20″ | 99.0 | 107.0 | 113.0 | 120.0 | | |
| G 9 | 9″ | 36.0 | 38.5 | 43.5 | | G 20a | 20″ | 127.0 | 135.0 | 142.0 | 149.0 | | |
| G 10 | 10″ | 41.5 | 44.5 | 50.0 | | G 22 | 22″ | 101.0 | 108.0 | 116.0 | 124.0 | 132.0 | |
| G 12 | 12″ | 51.5 | 55.5 | 61.0 | | G 24 | 24″ | 107.0 | 113.0 | 120.0 | 128.0 | | |
| G 12a | 12″ | 66.0 | 70.5 | 76.5 | | G 24a | 24″ | 132.0 | 140.0 | 148.0 | | | |
| G 15 | 15″ | 64.5 | 69.0 | 74.0 | 80.5 | G 26 | 26″ | 138.0 | 144.0 | 151.0 | 160.0 | | |
| G 15a | 15″ | 94.0 | 99.0 | 105.0 | 111.0 | G 28 | 28″ | 145.0 | 156.0 | 165.0 | 175.0 | 186.0 | |
| G 15b | 15″ | 127.0 | 135.0 | 141.0 | 147.0 | G 30 | 30″ | 173.0 | 180.0 | 190.0 | 200.0 | 220.0 | 240.0 |
| G 16 | 16″ | 74.5 | 81.0 | 87.0 | 94.0 | G 33 | 33″ | 200.0 | 210.0 | 220.0 | 230.0 | 245.0 | 260.0 |
| G 18 | 18″ | 80.0 | 86.0 | 92.0 | 99.0 | G 36 | 36″ | 230.0 | 240.0 | 250.0 | 260.0 | 280.0 | 300.0 |

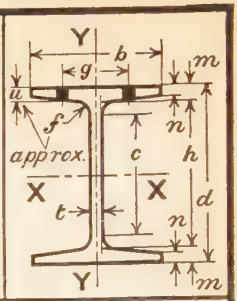
# 8" G

## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

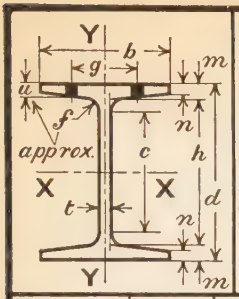
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | |
|---|---|---|---|---|---|
| Depth = d". | | 7.88 | 8.00 | 8.12 | Live Load deflection must not exceed 1/360 of the Span. |
| Wt. per foot. | | 29.5 | 33.0 | 36.5 | |
| Area. Sq. In.. | | 8.69 | 9.69 | 10.81 | |
| b"..... | | 7.995 | 8.000 | 8.020 | |
| t..... | | .285 | .290 | .310 | |
| h..... | | 6.738 | 6.738 | 6.738 | |
| m..... | | .571 | .631 | .691 | |
| n..... | | .250 | .310 | .370 | |
| f..... | | .40 | .40 | .40 | |
| c..... | | 5.938 | 5.938 | 5.938 | |
| g..... | | 5½ | 5½ | 5½ | |
| u..... | | 11/32 | 13/32 | 15/32 | |
| AXES X-X | I.... | 100.7 | 116.1 | 132.6 | Live Load Def. = Total Def. × Live Load / Tabular Load |
| | S.... | 25.56 | 29.03 | 32.66 | |
| | r.... | 3.41 | 3.46 | 3.50 | |
| AXES Y-Y | I.... | 28.4 | 33.6 | 39.0 | |
| | S.... | 7.10 | 8.39 | 9.72 | |
| | r.... | 1.81 | 1.86 | 1.90 | |
| Coef. Str.... | | 306700 | 348300 | 391900 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max. Mom. "M | | 460000 | 522500 | 587900 | |
| V..... | | 26900 | 27800 | 30200 | |
| P. feet.. | | 5.70 | 6.27 | 6.49 | |
| R..... | | 23400 | 23900 | 25700 | |
| W..... | | 25650 | 26100 | 27920 | |
| Q. feet . | | 5.98 | 6.67 | 7.02 | |
| w. lbs .. | | 16 | 16 | 16 | |
| Rivet dia... | | ⅞ | ⅞ | ⅞ | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|
| 5 | 54 | 54 | 56 | 56 | 60 | 60 | |
| 6 | 51 | 51 | 56 | 56 | 60 | 60 | .084 |
| 7 | 44 | 44 | 50 | 50 | 56 | 56 | .114 |
| 8 | 38 | 38 | 44 | 44 | 49 | 49 | .149 |
| 9 | 34 | 34 | 39 | 39 | 44 | 44 | .189 |
| 10 | 31 | 31 | 35 | 35 | 39 | 39 | .233 |
| 11 | 28 | 27 | 32 | 31 | 36 | 35 | .281 |
| 12 | 26 | 25 | 29 | 28 | 33 | 32 | .335 |
| 13 | 24 | 22 | 27 | 25 | 30 | 28 | .394 |
| 14 | 22 | 20 | 25 | 23 | 28 | 26 | .456 |
| 15 | 20 | 18 | 23 | 20 | 26 | 23 | .524 |
| 16 | 19 | 16 | 22 | 19 | 24 | 21 | .596 |
| 17 | 18 | 15 | 20 | 17 | 23 | 19 | .674 |
| 18 | 17 | 14 | 19 | 15 | 22 | 18 | .754 |
| 19 | 16 | 13 | 18 | 14 | 21 | 16 | .840 |
| 20 | 15 | 11 | 17 | 13 | 20 | 15 | .931 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 9″ G

| | | | | |
|---|---|---|---|---|
| Depth = d″. | | 8.94 | 9.00 | 9.12 |
| Wt. per foot. | | 36.0 | 38.5 | 43.5 |
| Area. Sq. In.. | | 10.66 | 11.35 | 12.73 |
| b″..... | | 8.480 | 8.500 | 8.540 |
| t..... | | .290 | .310 | .350 |
| h..... | | 7.628 | 7.628 | 7.628 |
| m..... | | .656 | .686 | .746 |
| n..... | | .315 | .345 | .405 |
| f..... | | .40 | .40 | .40 |
| c..... | | 6.875 | 6.875 | 6.875 |
| g..... | | 5½ | 5½ | 5½ |
| u..... | | 15/32 | 15/32 | 9/16 |
| AXES X-X | I.... | 160.5 | 171.9 | 195 4 |
| | S.... | 35.91 | 38.20 | 42.85 |
| | r.... | 3.88 | 3.89 | 3.92 |
| AXES Y-Y | I.... | 41.0 | 44.4 | 51.3 |
| | S.... | 9.67 | 10.4 | 12.0 |
| | r .... | 1.96 | 1.98 | 2.01 |
| Coef. Str.... | | 430900 | 458400 | 514200 |
| Max. Mom. "#" | | 646300 | 687600 | 771300 |
| V..... | | 31100 | 33500 | 38300 |
| P. feet.. | | 6.93 | 6.84 | 6.71 |
| R..... | | 25000 | 26700 | 30200 |
| W..... | | 26100 | 27900 | 31500 |
| Q. feet.. | | 8.26 | 8.22 | 8.16 |
| w. lbs... | | 16 | 16 | 16 |
| Rivet dia.... | | ⅞ | ⅞ | ⅞ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 5 | 62 | 62 | 67 | 67 | 77 | 77 | |
| 6 | 62 | 62 | 67 | 67 | 77 | 77 | |
| 7 | 62 | 62 | 66 | 66 | 74 | 74 | .101 |
| 8 | 54 | 54 | 57 | 57 | 64 | 64 | .132 |
| 9 | 48 | 48 | 51 | 51 | 57 | 57 | .168 |
| 10 | 43 | 43 | 46 | 46 | 51 | 51 | .207 |
| 11 | 39 | 39 | 42 | 42 | 47 | 47 | .250 |
| 12 | 36 | 35 | 38 | 37 | 43 | 42 | .298 |
| 13 | 33 | 31 | 35 | 33 | 40 | 38 | .350 |
| 14 | 31 | 29 | 33 | 31 | 37 | 34 | .406 |
| 15 | 29 | 26 | 31 | 28 | 34 | 31 | .466 |
| 16 | 27 | 24 | 29 | 26 | 32 | 28 | .530 |
| 17 | 25 | 22 | 27 | 23 | 30 | 26 | .599 |
| 18 | 24 | 20 | 25 | 21 | 29 | 24 | 670 |
| 19 | 23 | 19 | 24 | 20 | 27 | 22 | .747 |
| 20 | 22 | 17 | 23 | 18 | 26 | 21 | .828 |

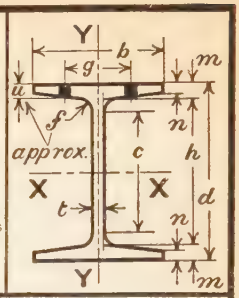
# 10" G

## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



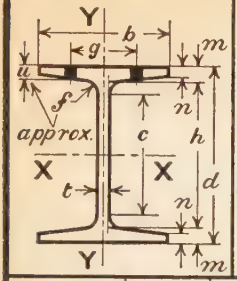

| | | | | |
|---|---|---|---|---|
| Depth = d". | | 9.91 | 10.00 | 10.12 |
| Wt. per foot. | | 41.5 | 44.5 | 50.0 |
| Area. Sq. In.. | | 12.23 | 13.14 | 14.62 |
| b" | | 8.990 | 9.000 | 9.040 |
| t | | .310 | .320 | .360 |
| h | | 8.506 | 8.506 | 8.506 |
| m | | .702 | .747 | .807 |
| n | | .340 | 385 | .445 |
| f | | .40 | .40 | .40 |
| c | | 7.750 | 7.750 | 7.750 |
| g | | 5½ | 5½ | 5½ |
| u | | ½ | 9/16 | 5/8 |
| AXES X-X | I | 225.8 | 246.7 | 277.5 |
| | S | 45.57 | 49.34 | 54.84 |
| | r | 4.30 | 4.33 | 4.36 |
| AXES Y-Y | I | 52.6 | 58.2 | 66.4 |
| | S | 11.7 | 12.9 | 14.7 |
| | r | 2.07 | 2.10 | 2.13 |
| Coef. Str. | | 546800 | 592100 | 658100 |
| Max. Mom. "# | | 820300 | 888100 | 987100 |
| V | | 36900 | 38400 | 43700 |
| P. feet | | 7.41 | 7.71 | 7.53 |
| R | | 27900 | 28800 | 32400 |
| W | | 27900 | 28800 | 32400 |
| Q. feet | | 9.80 | 10.28 | 10.16 |
| w. lbs | | 16 | 16 | 16 |
| Rivet dia | | 7/8 | 7/8 | 7/8 |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|
| 6 | 74 | 74 | 77 | 77 | 87 | 87 | |
| 7 | 74 | 74 | 77 | 77 | 87 | 87 | |
| 8 | 68 | 68 | 74 | 74 | 82 | 82 | .119 |
| 9 | 61 | 61 | 66 | 66 | 73 | 73 | .151 |
| 10 | 55 | 55 | 59 | 59 | 66 | 66 | .186 |
| 11 | 50 | 50 | 54 | 54 | 60 | 60 | .225 |
| 12 | 46 | 45 | 49 | 48 | 55 | 54 | .268 |
| 13 | 42 | 41 | 46 | 44 | 51 | 49 | .315 |
| 14 | 39 | 37 | 42 | 40 | 47 | 45 | .365 |
| 15 | 36 | 33 | 39 | 36 | 44 | 41 | .419 |
| 16 | 34 | 31 | 37 | 34 | 41 | 37 | .477 |
| 17 | 32 | 28 | 35 | 31 | 39 | 35 | .539 |
| 18 | 30 | 26 | 33 | 28 | 37 | 32 | .603 |
| 19 | 29 | 24 | 31 | 26 | 35 | 30 | .672 |
| 20 | 27 | 22 | 30 | 25 | 33 | 27 | .745 |
| 21 | 26 | 21 | 28 | 22 | 31 | 25 | .821 |
| 22 | 25 | 19 | 27 | 21 | 30 | 23 | .901 |
| 23 | 24 | 18 | 26 | 20 | 29 | 22 | .986 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 12" G

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d". | | 11.91 | 12.00 | 12.12 | 11.88 | 12.00 | 12.12 |
| Wt. per foot. | | 51.5 | 55.5 | 61.0 | 66.0 | 70.5 | 76.5 |
| Area. Sq. In.. | | 15.21 | 16.35 | 17.92 | 19.32 | 20.79 | 22.50 |
| b"..... | | 9.980 | 10.000 | 10.030 | 10.230 | 10.250 | 10.290 |
| t..... | | .360 | .380 | .410 | .450 | .470 | .510 |
| h..... | | 10.388 | 10.388 | 10.388 | 10.066 | 10.066 | 10.066 |
| m..... | | .761 | .806 | .866 | .907 | .967 | 1.027 |
| n..... | | .360 | .405 | .465 | .500 | .560 | .620 |
| f..... | | .45 | .45 | .45 | .55 | .55 | .55 |
| c..... | | 9.5 | 9.5 | 9.5 | 9.0 | 9.0 | 9.0 |
| g..... | | 5½ | 5½ | 5½ | 5½ | 5½ | 5½ |
| u..... | | 9/16 | 5/8 | 11/16 | 23/32 | 25/32 | 13/16 |
| AXES X-X | I.... | 400.6 | 435.6 | 483.6 | 496.9 | 543.6 | 594.2 |
| | S.... | 67.27 | 72.60 | 79.80 | 83.65 | 90.60 | 98.05 |
| | r.... | 5.13 | 5.16 | 5.20 | 5.07 | 5.11 | 5.14 |
| AXES Y-Y | I.... | 76.9 | 84.9 | 95.9 | 108.3 | 119.7 | 132.1 |
| | S.... | 15.4 | 17.0 | 19.1 | 21.2 | 23.4 | 25.7 |
| | r.... | 2.25 | 2.28 | 2.31 | 2.37 | 2.40 | 2.42 |
| Coef. Str.... | | 807300 | 871200 | 957600 | 1003800 | 1087200 | 1176600 |
| Max. Mom."# | | 1210900 | 1306800 | 1436400 | 1505800 | 1630800 | 1764900 |
| V..... | | 51500 | 54700 | 59700 | 64100 | 67700 | 74200 |
| P. feet.. | | 7.84 | 7.96 | 8.02 | 7.83 | 8.03 | 7.93 |
| R..... | | 35100 | 37100 | 40000 | 43900 | 45800 | 49700 |
| W..... | | 48600 | 51300 | 55350 | 60750 | 63450 | 68850 |
| Q. feet . | | 8.31 | 8.49 | 8.65 | 8.26 | 8.57 | 8.54 |
| w. lbs... | | 24 | 24 | 24 | 24 | 24 | 24 |
| Rivet dia.... | | 1" | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 103 | 103 | 109 | 109 | 119 | 119 | 128 | 128 | 135 | 135 | 148 | 148 | |
| 7 | 103 | 103 | 109 | 109 | 119 | 119 | 128 | 128 | 135 | 135 | 148 | 148 | |
| 8 | 101 | 101 | 109 | 109 | 119 | 119 | 126 | 126 | 135 | 135 | 147 | 147 | |
| 9 | 90 | 90 | 97 | 97 | 106 | 106 | 112 | 112 | 121 | 121 | 131 | 131 | .126 |
| 10 | 81 | 81 | 87 | 87 | 96 | 96 | 100 | 100 | 109 | 109 | 118 | 118 | .155 |
| 11 | 73 | 73 | 79 | 79 | 87 | 87 | 91 | 91 | 99 | 99 | 107 | 107 | .188 |
| 12 | 67 | 67 | 73 | 73 | 80 | 80 | 84 | 84 | 91 | 91 | 98 | 98 | .223 |
| 13 | 62 | 61 | 67 | 66 | 74 | 73 | 77 | 77 | 84 | 84 | 91 | 91 | .263 |
| 14 | 58 | 56 | 62 | 60 | 68 | 66 | 72 | 71 | 78 | 76 | 84 | 82 | .304 |
| 15 | 54 | 52 | 58 | 55 | 64 | 61 | 67 | 64 | 72 | 69 | 78 | 75 | .341 |
| 16 | 50 | 47 | 54 | 51 | 60 | 56 | 63 | 59 | 68 | 64 | 74 | 70 | .398 |
| 17 | 48 | 44 | 51 | 47 | 56 | 52 | 59 | 55 | 64 | 59 | 69 | 64 | .449 |
| 18 | 45 | 41 | 48 | 43 | 53 | 48 | 56 | 51 | 60 | 55 | 65 | 59 | .503 |
| 19 | 43 | 38 | 46 | 41 | 50 | 44 | 53 | 47 | 57 | 51 | 62 | 55 | .560 |
| 20 | 40 | 35 | 44 | 38 | 48 | 41 | 50 | 44 | 54 | 47 | 59 | 52 | .621 |
| 21 | 38 | 32 | 41 | 35 | 46 | 39 | 48 | 41 | 52 | 44 | 56 | 48 | .684 |
| 22 | 37 | 30 | 40 | 33 | 44 | 36 | 46 | 38 | 49 | 41 | 54 | 45 | .751 |
| 23 | 35 | 28 | 38 | 31 | 42 | 34 | 44 | 36 | 47 | 38 | 51 | 42 | .822 |
| 24 | 34 | 27 | 36 | 28 | 40 | 31 | 42 | 33 | 45 | 36 | 49 | 39 | .894 |
| 25 | 32 | 24 | 35 | 27 | 38 | 29 | 40 | 31 | 43 | 33 | 47 | 37 | .970 |

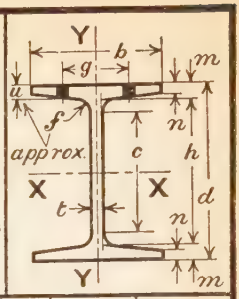
# 15" G

## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d" | | 14 82 | 14.88 | 15 00 | 15 12 | 14 80 | 14 88 | 15.00 | 15.12 |
| Wt. per foot. | | 64 5 | 69 0 | 74.0 | 80 5 | 94 0 | 99 0 | 105 0 | 111.0 |
| Area. Sq. In.. | | 19.09 | 20.18 | 21 76 | 23 66 | 27 66 | 29 00 | 30 80 | 32.75 |
| b"..... | | 10.700 | 10.730 | 10 750 | 10.790 | 11 190 | 11 220 | 11.250 | 11.290 |
| t..... | | .390 | .420 | 440 | 480 | 540 | .570 | .600 | .640 |
| h..... | | 13.120 | 13.120 | 13.120 | 13.120 | 12 542 | 12 542 | 12 542 | 12 542 |
| m..... | | .850 | .880 | .940 | 1 000 | 1.129 | 1 169 | 1.229 | 1.289 |
| n..... | | .420 | .450 | .510 | .570 | .685 | .725 | 785 | .845 |
| f..... | | .55 | .55 | .55 | .55 | 70 | 70 | .70 | .70 |
| c..... | | 12.125 | 12.125 | 12 125 | 12 125 | 11 250 | 11 250 | 11 250 | 11.250 |
| g..... | | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ |
| u..... | | 9/16 | 19/32 | 21/32 | 23/32 | 27/32 | 7/8 | 15/16 | 1" |
| AXES X-X | I.... | 771.6 | 815.3 | 892 7 | 977 4 | 1090.2 | 1147 7 | 1231 3 | 1319 3 |
| | S.... | 104 13 | 109.58 | 119.03 | 129.29 | 147.32 | 154.26 | 164.17 | 174.51 |
| | r.... | 6.36 | 6.36 | 6.40 | 6.43 | 6.28 | 6.29 | 6.32 | 6.35 |
| AXES Y-Y | I.... | 108.6 | 115.8 | 128.9 | 143.1 | 187 4 | 198.5 | 214.4 | 231.3 |
| | S.... | 20.3 | 21.6 | 24 0 | 26.5 | 33.5 | 35.4 | 38.1 | 41.0 |
| | r.... | 2.39 | 2.40 | 2.43 | 2.46 | 2.60 | 2 62 | 2.64 | 2 66 |
| Coef. Str.... | | 1249500 | 1315000 | 1428300 | 1551400 | 1767900 | 1851100 | 1970100 | 2094100 |
| Max. Mom. "/# | | 1874300 | 1972500 | 2142500 | 2327100 | 2651800 | 2776700 | 2955100 | 3141200 |
| V .... | | 69400 | 75000 | 79200 | 87100 | 95900 | 101700 | 108000 | 116200 |
| P. feet.. | | 9 00 | 8 77 | 9.02 | 8.91 | 9.22 | 9.10 | 9 12 | 9.01 |
| R..... | | 41000 | 45200 | 47900 | 52200 | 58700 | 62000 | 65300 | 69600 |
| W..... | | 70200 | 75600 | 79200 | 86400 | 95440 | 95440 | 95440 | 95440 |
| Q. feet.. | | 8 90 | 8.70 | 9.02 | 8.98 | 9.26 | 9.70 | 10 32 | 10.97 |
| w. lbs... | | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Rivet dia.... | | 1" | 1" | 1" | 1" | 1" | 1" | 1" | 1" |

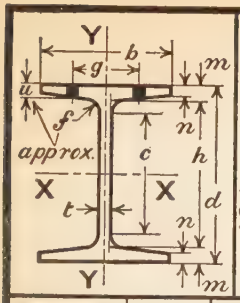
Live Load deflection must not exceed 1/360 of the span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Total Deflection in inches for Maximum Load; Laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 139 | 139 | 150 | 150 | 158 | 158 | 174 | 174 | 192 | 192 | 203 | 203 | 216 | 216 | 232 | 232 | |
| 7 | 139 | 139 | 150 | 150 | 158 | 158 | 174 | 174 | 192 | 192 | 203 | 203 | 216 | 216 | 232 | 232 | |
| 8 | 139 | 139 | 150 | 150 | 158 | 158 | 174 | 174 | 192 | 192 | 203 | 203 | 216 | 216 | 232 | 232 | |
| 9 | 139 | 139 | 146 | 146 | 158 | 158 | 172 | 172 | 192 | 192 | 203 | 203 | 216 | 216 | 232 | 232 | .101 |
| 10 | 125 | 125 | 132 | 132 | 143 | 143 | 155 | 155 | 177 | 177 | 185 | 185 | 197 | 197 | 209 | 209 | .124 |
| 11 | 114 | 114 | 120 | 120 | 130 | 130 | 141 | 141 | 161 | 161 | 168 | 168 | 179 | 179 | 190 | 190 | .150 |
| 12 | 104 | 104 | 110 | 110 | 119 | 119 | 129 | 129 | 147 | 147 | 154 | 154 | 164 | 164 | 175 | 175 | .179 |
| 13 | 96 | 96 | 101 | 101 | 110 | 110 | 119 | 119 | 136 | 136 | 142 | 142 | 152 | 152 | 161 | 161 | .210 |
| 14 | 89 | 88 | 94 | 93 | 102 | 101 | 111 | 110 | 126 | 126 | 132 | 132 | 141 | 141 | 150 | 150 | .243 |
| 15 | 83 | 81 | 88 | 86 | 95 | 93 | 103 | 100 | 118 | 116 | 123 | 121 | 131 | 129 | 140 | 138 | .279 |
| 16 | 78 | 75 | 82 | 79 | 89 | 85 | 97 | 93 | 111 | 107 | 116 | 112 | 123 | 119 | 131 | 127 | .318 |
| 17 | 74 | 70 | 77 | 72 | 84 | 79 | 91 | 86 | 104 | 99 | 109 | 104 | 116 | 111 | 123 | 117 | .359 |
| 18 | 69 | 64 | 73 | 67 | 79 | 73 | 86 | 80 | 98 | 92 | 103 | 96 | 109 | 102 | 116 | 109 | .402 |
| 19 | 66 | 60 | 69 | 63 | 75 | 68 | 82 | 75 | 93 | 86 | 97 | 89 | 104 | 96 | 110 | 102 | .448 |
| 20 | 63 | 56 | 66 | 59 | 71 | 63 | 78 | 70 | 88 | 80 | 93 | 84 | 99 | 90 | 105 | 95 | .497 |
| 21 | 60 | 52 | 63 | 55 | 68 | 59 | 74 | 65 | 84 | 74 | 88 | 78 | 94 | 83 | 100 | 89 | .547 |
| 22 | 57 | 49 | 60 | 51 | 65 | 55 | 71 | 61 | 80 | 70 | 84 | 73 | 90 | 78 | 95 | 83 | .601 |
| 23 | 54 | 45 | 57 | 48 | 62 | 52 | 67 | 56 | 77 | 66 | 81 | 69 | 86 | 73 | 91 | 78 | .651 |
| 24 | 52 | 42 | 55 | 45 | 60 | 49 | 65 | 53 | 74 | 62 | 77 | 64 | 82 | 69 | 87 | 73 | .715 |
| 25 | 50 | 40 | 53 | 42 | 57 | 46 | 62 | 50 | 71 | 58 | 74 | 61 | 79 | 65 | 84 | 69 | .776 |
| 26 | 48 | 37 | 51 | 40 | 55 | 43 | 60 | 47 | 68 | 54 | 71 | 57 | 76 | 61 | 81 | 65 | .839 |
| 27 | 46 | 35 | 49 | 37 | 53 | 41 | 57 | 44 | 66 | 52 | 69 | 54 | 73 | 57 | 78 | 61 | .905 |
| 28 | 45 | 33 | 47 | 35 | 51 | 38 | 55 | 41 | 63 | 48 | 66 | 51 | 70 | 54 | 75 | 58 | .973 |
| 29 | 43 | 31 | 45 | 33 | 49 | 36 | 54 | 39 | 61 | 46 | 64 | 48 | 68 | 51 | 72 | 54 | 1.040 |
| 30 | 42 | 30 | 44 | 31 | 48 | 34 | 52 | 37 | 59 | 43 | 62 | 45 | 66 | 48 | 70 | 52 | 1.120 |
| 32 | 39 | 26 | 41 | 28 | 45 | 31 | 48 | 33 | 55 | 38 | 58 | 41 | 62 | 44 | 65 | 46 | 1.270 |
| 34 | 37 | 24 | 39 | 25 | 42 | 27 | 46 | 30 | 52 | 35 | 54 | 36 | 58 | 39 | 62 | 42 | 1.440 |
| 36 | ... | .. | 37 | .. | 40 | .. | 43 | . | . | . | 51 | 33 | 55 | 35 | 58 | 37 | 1.610 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 15" G

| | | | | | |
|---|---|---|---|---|---|
| Depth = d". | | 14.75 | 14.88 | 15.00 | 15.12 |
| Wt. per foot. | | 127.0 | 135.0 | 141.0 | 147.0 |
| Area. Sq. In.. | | 37.47 | 39.58 | 41.44 | 43.30 |
| b"..... | | 11.680 | 11.720 | 11.750 | 11.780 |
| t..... | | .730 | .770 | .800 | .830 |
| h..... | | 11.908 | 11.908 | 11.908 | 11.908 |
| m..... | | 1.421 | 1.486 | 1.546 | 1.606 |
| n..... | | .965 | 1.030 | 1.090 | 1.150 |
| f..... | | .90 | .90 | .90 | .90 |
| c..... | | 10.250 | 10.250 | 10.250 | 10.250 |
| g..... | | 7½ | 7½ | 7½ | 7½ |
| u..... | | 1⅛ | 17/32 | 19/32 | 15/16 |
| AXES X-X | I.... | 1415.6 | 1509.9 | 1596.8 | 1685.4 |
| | S.... | 191.95 | 202.94 | 212.91 | 222.94 |
| | r.... | 6.15 | 6.18 | 6.21 | 6.24 |
| AXES Y-Y | I.... | 289.1 | 309.7 | 328.5 | 347.5 |
| | S.... | 49.5 | 52.9 | 55.9 | 59.0 |
| | r.... | 2.78 | 2.80 | 2.82 | 2.83 |
| Coef. Str.... | | 2303300 | 2435300 | 2554900 | 2675200 |
| Max. Mom."/# | | 3455000 | 3653000 | 3832300 | 4012800 |
| V..... | | 129200 | 137400 | 144000 | 150600 |
| P. feet.. | | 8.91 | 8.86 | 8.87 | 8.88 |
| R..... | | 79400 | 83700 | 87000 | 90300 |
| W..... | | 95440 | 95440 | 95440 | 95440 |
| Q. feet.. | | 12.07 | 12.76 | 13.38 | 14.02 |
| w. lbs... | | 33 | 33 | 33 | 33 |
| Rivet dia.... | | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 258 | 258 | 275 | 275 | 288 | 288 | 301 | 301 | |
| 7 | 258 | 258 | 275 | 275 | 288 | 288 | 301 | 301 | |
| 8 | 258 | 258 | 275 | 275 | 288 | 288 | 301 | 301 | |
| 9 | 256 | 256 | 271 | 271 | 284 | 284 | 297 | 297 | .101 |
| 10 | 230 | 230 | 243 | 243 | 255 | 255 | 267 | 267 | .124 |
| 11 | 209 | 209 | 221 | 221 | 232 | 232 | 243 | 243 | .150 |
| 12 | 192 | 192 | 203 | 203 | 213 | 213 | 223 | 223 | .179 |
| 13 | 177 | 177 | 187 | 187 | 197 | 197 | 206 | 206 | .210 |
| 14 | 165 | 165 | 174 | 174 | 182 | 182 | 191 | 191 | .243 |
| 15 | 154 | 153 | 162 | 161 | 170 | 169 | 178 | 177 | .279 |
| 16 | 144 | 141 | 152 | 149 | 160 | 157 | 167 | 164 | .318 |
| 17 | 136 | 131 | 143 | 138 | 150 | 145 | 157 | 152 | .359 |
| 18 | 128 | 121 | 135 | 128 | 142 | 135 | 149 | 142 | .402 |
| 19 | 121 | 113 | 128 | 120 | 134 | 125 | 141 | 132 | .448 |
| 20 | 115 | 106 | 122 | 112 | 128 | 118 | 134 | 123 | .497 |
| 21 | 110 | 99 | 116 | 105 | 122 | 110 | 127 | 115 | .547 |
| 22 | 105 | 93 | 111 | 98 | 116 | 103 | 122 | 108 | .601 |
| 23 | 100 | 87 | 106 | 92 | 111 | 97 | 116 | 101 | .651 |
| 24 | 96 | 82 | 101 | 86 | 106 | 90 | 111 | 95 | .715 |
| 25 | 92 | 77 | 97 | 81 | 102 | 86 | 107 | 90 | .776 |
| 26 | 89 | 73 | 94 | 77 | 98 | 80 | 103 | 85 | .839 |
| 27 | 85 | 68 | 90 | 72 | 95 | 76 | 99 | 80 | .905 |
| 28 | 82 | 64 | 87 | 68 | 91 | 72 | 96 | 76 | .973 |
| 29 | 79 | 61 | 84 | 65 | 88 | 68 | 92 | 71 | 1.040 |
| 30 | 77 | 58 | 81 | 61 | 85 | 64 | 89 | 67 | 1.120 |
| 32 | 72 | 52 | 76 | 55 | 80 | 58 | 84 | 61 | 1.270 |
| 34 | 68 | 47 | 72 | 50 | 75 | 52 | 79 | 55 | 1.440 |
| 36 | ... | ... | 68 | 45 | 71 | 47 | 74 | 49 | 1.610 |

# 16" G

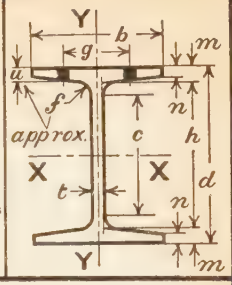
## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration

V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

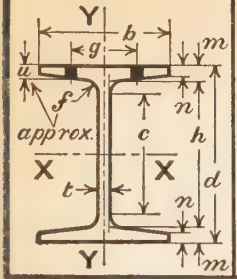
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d". | | 15.88 | 16.00 | 16.12 | 16.25 | Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load |
| Wt. per foot. | | 74.5 | 81.0 | 87.0 | 94 0 | |
| Area. Sq. In.. | | 21.96 | 23.82 | 25.68 | 27.75 | |
| b"..... | | 11.470 | 11.500 | 11.530 | 11.565 | |
| t..... | | .390 | .420 | .450 | .485 | |
| h..... | | 14.018 | 14.018 | 14.018 | 14.018 | |
| m..... | | .931 | .991 | 1.051 | 1.116 | |
| n..... | | .469 | .529 | .589 | .654 | |
| f..... | | .60 | .60 | .60 | .60 | |
| c..... | | 12.875 | 12.875 | 12.875 | 12.875 | |
| g..... | | 7½ | 7½ | 7½ | 7½ | |
| u..... | | 5/8 | 11/16 | ¾ | 13/16 | |
| AXES X-X | I.... | 1033.6 | 1131.3 | 1230.8 | 1341.4 | |
| | S.... | 130.18 | 141.41 | 152.70 | 165.10 | |
| | r.... | 6.86 | 6.89 | 6.92 | 6.95 | |
| AXES Y-Y | I.... | 148.1 | 164.6 | 181.3 | 199.9 | |
| | S.... | 25.8 | 28.6 | 31.5 | 34.6 | |
| | r.... | 2.60 | 2.63 | 2.66 | 2.68 | |
| Coef. Str.... | | 1562100 | 1696900 | 1832400 | 1981100 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max.Mom."# | | 2343200 | 2545400 | 2748700 | 2971700 | |
| V..... | | 74300 | 80600 | 87000 | 94600 | |
| P. feet.. | | 10.51 | 10.53 | 10.53 | 10.47 | |
| R..... | | 41300 | 45700 | 50000 | 54600 | |
| W..... | | 70200 | 75600 | 81000 | 87300 | |
| Q. feet.. | | 11.13 | 11.22 | 11.31 | 11.35 | |
| w. lbs... | | 33 | 33 | 33 | 33 | |
| Rivet dia.... | | 1" | 1" | 1" | 1" | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 149 | 149 | 161 | 161 | 174 | 174 | 189 | 189 | |
| 11 | 142 | 142 | 154 | 154 | 167 | 167 | 180 | 180 | |
| 12 | 130 | 130 | 141 | 141 | 153 | 153 | 165 | 165 | |
| 13 | 120 | 120 | 131 | 131 | 141 | 141 | 152 | 152 | |
| 14 | 112 | 112 | 121 | 121 | 131 | 131 | 142 | 142 | |
| 15 | 104 | 103 | 113 | 112 | 122 | 121 | 132 | 131 | .262 |
| 16 | 98 | 96 | 106 | 104 | 115 | 112 | 124 | 121 | .298 |
| 17 | 92 | 88 | 100 | 96 | 108 | 104 | 117 | 113 | .336 |
| 18 | 87 | 82 | 94 | 89 | 102 | 96 | 110 | 104 | .377 |
| 19 | 82 | 76 | 89 | 83 | 96 | 89 | 104 | 97 | .420 |
| 20 | 78 | 71 | 85 | 78 | 92 | 84 | 99 | 91 | .466 |
| 21 | 74 | 66 | 81 | 73 | 87 | 78 | 94 | 85 | .513 |
| 22 | 71 | 62 | 77 | 68 | 83 | 73 | 90 | 79 | .563 |
| 23 | 68 | 59 | 74 | 64 | 80 | 69 | 86 | 74 | .616 |
| 24 | 65 | 55 | 71 | 60 | 76 | 64 | 83 | 70 | .670 |
| 25 | 63 | 52 | 68 | 56 | 73 | 61 | 79 | 66 | .727 |
| 26 | 60 | 49 | 65 | 53 | 71 | 58 | 76 | 62 | .787 |
| 27 | 58 | 46 | 63 | 50 | 68 | 54 | 73 | 58 | .848 |
| 28 | 56 | 43 | 61 | 48 | 65 | 51 | 71 | 55 | .912 |
| 29 | 54 | 41 | 59 | 45 | 63 | 48 | 68 | 52 | .979 |
| 30 | 52 | 39 | 57 | 43 | 61 | 46 | 66 | 49 | 1.047 |
| 32 | 49 | 35 | 53 | 38 | 57 | 41 | 62 | 44 | 1.192 |
| 34 | 46 | 31 | 50 | 34 | 54 | 37 | 58 | 40 | 1.346 |
| 36 | 43 | 28 | 47 | 31 | 51 | 33 | 55 | 36 | 1.508 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 18″ G

| | | | | | |
|---|---|---|---|---|---|
| Depth = d″. | | 17.88 | 18.00 | 18.12 | 18.25 |
| Wt. per foot. | | 80.0 | 86.0 | 92.0 | 99.0 |
| Area. Sq. In.. | | 23.59 | 25.35 | 27.13 | 29.11 |
| b″..... | | 11.730 | 11.750 | 11.770 | 11.795 |
| t..... | | .420 | .440 | .460 | .485 |
| h..... | | 16.01 | 16.01 | 16.01 | 16.01 |
| m..... | | .935 | .995 | 1.055 | 1.120 |
| n..... | | .464 | .524 | .584 | .649 |
| f..... | | .60 | .60 | .60 | .60 |
| c..... | | 14.875 | 14.875 | 14.875 | 14.875 |
| g..... | | 7½ | 7½ | 7½ | 7½ |
| u..... | | ⅝ | 11/16 | ¾ | 13/16 |
| AXES X-X | I.... | 1380.7 | 1503.6 | 1628.5 | 1767.7 |
| | S.... | 154.44 | 167.07 | 179.75 | 193.72 |
| | r.... | 7.65 | 7.70 | 7.75 | 7.79 |
| AXES Y-Y | I.... | 157.8 | 174.9 | 192.2 | 211.3 |
| | S.... | 26.9 | 29.8 | 32.7 | 35.8 |
| | r.... | 2.59 | 2.63 | 2.66 | 2.69 |
| Coef. Str.... | | 1853300 | 2004800 | 2157000 | 2324600 |
| Max. Mom. ″# | | 2779900 | 3007200 | 3235400 | 3487000 |
| V..... | | 90100 | 95000 | 100000 | 106200 |
| P. feet.. | | 10.28 | 10.55 | 10.79 | 10.94 |
| R..... | | 46200 | 49500 | 52800 | 56900 |
| W..... | | 94500 | 99000 | 103500 | 109100 |
| Q. feet.. | | 9.81 | 10.13 | 10.42 | 10.65. |
| w. lbs... | | 41 | 41 | 41 | 41 |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 180 | 180 | 190 | 190 | 200 | 200 | 212 | 212 | |
| 9 | 180 | 180 | 190 | 190 | 200 | 200 | 212 | 212 | |
| 10 | 180 | 180 | 190 | 190 | 200 | 200 | 212 | 212 | |
| 11 | 168 | 168 | 182 | 182 | 196 | 196 | 211 | 211 | 125 |
| 12 | 154 | 154 | 167 | 167 | 180 | 180 | 194 | 194 | .149 |
| 13 | 143 | 143 | 154 | 154 | 166 | 166 | 179 | 179 | .175 |
| 14 | 132 | 132 | 143 | 143 | 154 | 154 | 166 | 166 | .203 |
| 15 | 124 | 123 | 134 | 133 | 144 | 143 | 155 | 154 | .233 |
| 16 | 116 | 114 | 125 | 123 | 135 | 132 | 145 | 142 | 265 |
| 17 | 109 | 105 | 118 | 114 | 127 | 123 | 137 | 132 | .299 |
| 18 | 103 | 98 | 111 | 105 | 120 | 114 | 129 | 123 | .335 |
| 19 | 98 | 92 | 106 | 99 | 114 | 107 | 122 | 114 | .373 |
| 20 | 93 | 85 | 100 | 92 | 108 | 99 | 116 | 107 | .414 |
| 21 | 88 | 79 | 95 | 86 | 103 | 93 | 111 | 100 | .456 |
| 22 | 84 | 74 | 91 | 81 | 98 | 87 | 106 | 94 | .501 |
| 23 | 81 | 71 | 87 | 76 | 94 | 82 | 101 | 88 | .548 |
| 24 | 77 | 66 | 84 | 72 | 90 | 77 | 97 | 83 | .596 |
| 25 | 74 | 62 | 80 | 67 | 86 | 72 | 93 | 78 | .647 |
| 26 | 71 | 58 | 77 | 63 | 83 | 68 | 89 | 73 | .699 |
| 27 | 69 | 56 | 74 | 60 | 80 | 64 | 86 | 69 | .754 |
| 28 | 66 | 52 | 72 | 57 | 77 | 61 | 83 | 66 | 811 |
| 29 | 64 | 49 | 69 | 53 | 74 | 57 | 80 | 62 | 870 |
| 30 | 62 | 47 | 67 | 51 | 72 | 54 | 77 | 58 | .931 |
| 32 | 58 | 42 | 63 | 46 | 67 | 49 | 73 | 53 | 1.06 |
| 34 | 55 | 38 | 59 | 41 | 63 | 44 | 68 | 47 | 1.20 |
| 36 | 51 | 34 | 56 | 37 | 60 | 40 | 65 | 43 | 1.34 |
| 38 | 49 | 31 | 53 | 34 | 57 | 36 | 61 | 39 | 1.49 |
| 40 | 46 | ... | 50 | ... | 54 | ... | 58 | ... | 1.66 |

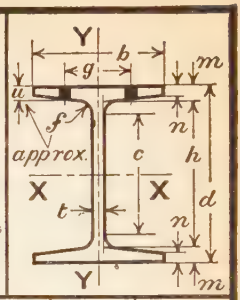
# 20″ G

## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



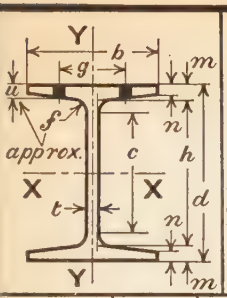

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth = d″. | 19.75 | 19.88 | 20.00 | 20.12 | 19.75 | 19.88 | 20.00 | 20.12 |
| Wt. per foot. | 99.0 | 107.0 | 113.0 | 120.0 | 127.0 | 135.0 | 142.0 | 149.0 |
| Area. Sq. In.. | 29.21 | 31.36 | 33.20 | 35.24 | 37.33 | 39.58 | 41.71 | 43.84 |
| b″..... | 11.950 | 11.980 | 12.000 | 12.030 | 12.690 | 12.720 | 12.750 | 12.780 |
| t..... | .510 | .540 | .560 | .590 | .600 | .630 | .660 | .690 |
| h..... | 17.626 | 17.626 | 17.626 | 17.626 | 17.170 | 17.170 | 17.170 | 17.170 |
| m..... | 1.062 | 1.127 | 1.187 | 1.247 | 1.289 | 1.354 | 1.414 | 1.474 |
| n..... | .585 | .650 | .710 | .770 | .785 | .851 | .911 | .971 |
| f..... | .65 | .65 | .65 | .65 | .75 | .75 | .75 | .75 |
| c..... | 16.375 | 16.375 | 16.375 | 16.375 | 15.750 | 15.750 | 15.750 | 15.750 |
| g..... | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ |
| u..... | 25/32 | 13/16 | 7/8 | 15/16 | 1″ | 11/16 | 13/32 | 15/32 |
| AXES X-X I.... | 2034.4 | 2206.5 | 2362.8 | 2528.0 | 2607.3 | 2788.9 | 2960.6 | 3134.9 |
| AXES X-X S.... | 206.02 | 221.98 | 236.28 | 251.29 | 264.03 | 280.57 | 296.06 | 311.62 |
| AXES X-X r.... | 8.35 | 8.39 | 8.44 | 8.47 | 8.36 | 8.39 | 8.43 | 8.46 |
| AXES Y-Y I.... | 202 1 | 222.4 | 240.8 | 260.2 | 313.0 | 337.7 | 361.0 | 384 6 |
| AXES Y-Y S.... | 33.8 | 37.1 | 40.1 | 43.3 | 49.3 | 53.1 | 56.6 | 60 2 |
| AXES Y-Y r.... | 2 63 | 2.66 | 2.69 | 2.72 | 2.90 | 2.92 | 2.94 | 2 96 |
| Coef. Str.... | 2472200 | 2663800 | 2835400 | 3015500 | 3168400 | 3366900 | 3552700 | 3739400 |
| Max.Mom.″# | 3708300 | 3995700 | 4253000 | 4523300 | 4752500 | 5050300 | 5329100 | 5609200 |
| V..... | 120900 | 128800 | 134400 | 142500 | 142200 | 150300 | 158400 | 166600 |
| P. feet.. | 10 22 | 10.34 | 10.55 | 10.58 | 11.14 | 11.20 | 11.21 | 11.22 |
| R..... | 62400 | 67200 | 70700 | 75200 | 76500 | 80300 | 84200 | 88000 |
| W..... | 114800 | 119300 | 119300 | 119300 | 119300 | 119300 | 119300 | 119300 |
| Q. feet.. | 10.77 | 11 16 | 11.88 | 12.64 | 13 28 | 14.11 | 14.89 | 15 67 |
| w. lbs... | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 |
| Rivet dia.... | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 242 | 242 | 258 | 258 | 269 | 269 | 285 | 285 | 284 | 284 | 301 | 301 | 317 | 317 | 333 | 333 | |
| 9 | 242 | 242 | 258 | 258 | 269 | 269 | 285 | 285 | 284 | 284 | 301 | 301 | 317 | 317 | 333 | 333 | |
| 10 | 242 | 242 | 258 | 258 | 269 | 269 | 285 | 285 | 284 | 284 | 301 | 301 | 317 | 317 | 333 | 333 | |
| 11 | 225 | 225 | 242 | 242 | 258 | 258 | 274 | 274 | 284 | 284 | 301 | 301 | 317 | 317 | 333 | 333 | |
| 12 | 206 | 206 | 222 | 222 | 236 | 236 | 251 | 251 | 264 | 264 | 281 | 281 | 296 | 296 | 312 | 312 | .134 |
| 13 | 190 | 190 | 205 | 205 | 218 | 218 | 232 | 232 | 244 | 244 | 259 | 259 | 273 | 273 | 288 | 288 | .158 |
| 14 | 177 | 177 | 190 | 190 | 203 | 203 | 215 | 215 | 226 | 226 | 240 | 240 | 254 | 254 | 267 | 267 | .183 |
| 15 | 165 | 165 | 178 | 178 | 189 | 189 | 201 | 201 | 211 | 211 | 224 | 224 | 237 | 237 | 249 | 249 | .210 |
| 16 | 155 | 153 | 167 | 164 | 177 | 174 | 188 | 185 | 198 | 197 | 210 | 209 | 222 | 221 | 234 | 234 | .239 |
| 17 | 145 | 141 | 157 | 152 | 167 | 162 | 177 | 172 | 186 | 183 | 198 | 195 | 209 | 206 | 220 | 217 | .270 |
| 18 | 137 | 131 | 148 | 142 | 158 | 151 | 168 | 161 | 176 | 171 | 187 | 182 | 197 | 192 | 208 | 202 | .302 |
| 19 | 130 | 122 | 140 | 132 | 149 | 140 | 159 | 150 | 167 | 160 | 177 | 170 | 187 | 179 | 197 | 189 | .336 |
| 20 | 124 | 115 | 133 | 123 | 142 | 131 | 151 | 140 | 158 | 149 | 168 | 158 | 178 | 168 | 187 | 177 | .373 |
| 21 | 118 | 107 | 127 | 116 | 135 | 123 | 144 | 131 | 151 | 140 | 160 | 149 | 169 | 157 | 178 | 166 | .411 |
| 22 | 112 | 100 | 121 | 108 | 129 | 115 | 137 | 123 | 144 | 132 | 153 | 140 | 162 | 148 | 170 | 156 | .451 |
| 23 | 108 | 95 | 116 | 102 | 123 | 108 | 131 | 115 | 138 | 124 | 146 | 131 | 154 | 139 | 163 | 147 | .493 |
| 24 | 103 | 89 | 111 | 96 | 118 | 102 | 126 | 109 | 132 | 117 | 140 | 124 | 148 | 131 | 156 | 138 | .537 |
| 25 | 99 | 84 | 107 | 91 | 113 | 96 | 121 | 103 | 127 | 110 | 135 | 117 | 142 | 124 | 150 | 131 | .582 |
| 26 | 95 | 79 | 102 | 85 | 109 | 91 | 116 | 97 | 122 | 104 | 130 | 111 | 137 | 117 | 144 | 123 | .630 |
| 27 | 92 | 75 | 99 | 81 | 105 | 86 | 112 | 91 | 117 | 98 | 125 | 105 | 132 | 111 | 139 | 117 | .679 |
| 28 | 88 | 70 | 95 | 76 | 101 | 81 | 108 | 86 | 113 | 93 | 120 | 99 | 127 | 105 | 134 | 111 | .736 |
| 29 | 85 | 66 | 92 | 72 | 98 | 77 | 104 | 82 | 109 | 88 | 116 | 94 | 123 | 100 | 129 | 105 | .783 |
| 30 | 82 | 63 | 89 | 68 | 95 | 73 | 100 | 77 | 106 | 84 | 112 | 89 | 118 | 94 | 125 | 99 | .838 |
| 32 | 77 | 56 | 83 | 61 | 89 | 65 | 94 | 69 | 99 | 76 | 105 | 80 | 111 | 85 | 117 | 90 | .954 |
| 34 | 73 | 51 | 78 | 55 | 83 | 58 | 89 | 63 | 93 | 68 | 99 | 73 | 105 | 77 | 110 | 81 | 1.08 |
| 36 | 69 | 46 | 74 | 50 | 79 | 53 | 84 | 57 | 88 | 62 | 94 | 66 | 99 | 70 | 104 | 74 | 1.21 |
| 38 | 65 | 42 | 70 | 45 | 75 | 48 | 79 | 51 | 83 | 56 | 89 | 60 | 94 | 64 | 98 | 67 | 1.34 |
| 40 | 62 | .. | 67 | ... | 71 | 44 | 75 | 46 | 79 | 51 | 84 | 55 | 89 | 58 | 93 | 61 | 1.49 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 22″ G

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d″. | | 21.88 | 22.00 | 22.12 | 22.25 | 22.38 | Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load |
| Wt. per foot. | | 101.0 | 108.0 | 116.0 | 124.0 | 132.0 | |
| Area. Sq. In.. | | 29.68 | 31.89 | 34.12 | 36.59 | 38.96 | |
| b″..... | | 12.970 | 13.000 | 13.030 | 13.065 | 13.095 | |
| t..... | | .450 | .480 | .510 | .545 | .575 | |
| h..... | | 19.798 | 19.798 | 19.798 | 19.798 | 19.798 | |
| m..... | | 1.041 | 1.101 | 1.161 | 1.226 | 1.291 | |
| n..... | | .519 | .579 | .639 | .704 | .769 | |
| f..... | | .65 | .65 | .65 | .65 | .65 | |
| c..... | | 18.625 | 18.625 | 18.625 | 18.625 | 18.625 | |
| g..... | | 7½ | 7½ | 7½ | 7½ | 7 ½ | |
| u..... | | ¾ | 13/16 | ⅞ | 15/16 | 1″ | |
| AXES X-X | I.... | 2590.4 | 2804.3 | 3021.2 | 3261.7 | 3501.2 | |
| | S.... | 236.78 | 254.94 | 273.16 | 293.19 | 312.89 | |
| | r.... | 9.34 | 9.38 | 9.41 | 9.44 | 9.48 | |
| AXES Y-Y | I.... | 238.1 | 261.9 | 286.0 | 312.6 | 339.3 | |
| | S.... | 36.7 | 40.3 | 43.9 | 47.9 | 51.8 | |
| | r.... | 2.83 | 2.87 | 2.90 | 2.92 | 2.95 | |
| Coef. Str.... | | 2841400 | 3059200 | 3278000 | 3518200 | 3754600 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max. Mom.″/# | | 4262100 | 4588800 | 4917000 | 5277300 | 5632000 | |
| V..... | | 118200 | 126700 | 135400 | 145500 | 154400 | |
| P. feet.. | | 12.02 | 12.07 | 12.10 | 12.09 | 12.16 | |
| R..... | | 52300 | 57600 | 62900 | 69100 | 75200 | |
| W..... | | 121600 | 129600 | 137800 | 143160 | 143160 | |
| Q. feet.. | | 11.68 | 11.80 | 11.89 | 12.29 | 13.11 | |
| w. lbs... | | 49 | 49 | 49 | 49 | 49 | |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ | 1″ | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span | Laterally | | Laterally | | Laterally | | Laterally | | Laterally | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| feet | fixed | free | fixed | free | fixed | free | fixed | free | fixed | free | |
| 12 | 236 | 236 | 253 | 253 | 271 | 271 | 291 | 291 | 309 | 309 | |
| 13 | 219 | 219 | 235 | 235 | 252 | 252 | 271 | 271 | 289 | 289 | |
| 14 | 203 | 203 | 219 | 219 | 234 | 234 | 251 | 251 | 268 | 268 | |
| 15 | 189 | 189 | 204 | 204 | 219 | 219 | 235 | 235 | 250 | 250 | |
| 16 | 178 | 178 | 191 | 191 | 205 | 205 | 220 | 220 | 235 | 235 | |
| 17 | 167 | 167 | 180 | 178 | 193 | 191 | 207 | 205 | 221 | 219 | .241 |
| 18 | 158 | 154 | 170 | 166 | 182 | 178 | 195 | 191 | 209 | 204 | .274 |
| 19 | 150 | 144 | 161 | 155 | 173 | 167 | 185 | 179 | 198 | 191 | .305 |
| 20 | 142 | 135 | 153 | 145 | 164 | 156 | 176 | 167 | 188 | 179 | .339 |
| 21 | 135 | 126 | 146 | 137 | 156 | 146 | 168 | 157 | 179 | 168 | .373 |
| 22 | 129 | 119 | 139 | 128 | 149 | 137 | 160 | 148 | 171 | 158 | .410 |
| 23 | 124 | 112 | 133 | 121 | 143 | 130 | 153 | 139 | 163 | 148 | .448 |
| 24 | 118 | 105 | 128 | 114 | 137 | 122 | 147 | 131 | 157 | 140 | .488 |
| 25 | 114 | 100 | 122 | 107 | 131 | 115 | 141 | 124 | 150 | 132 | .529 |
| 26 | 109 | 94 | 118 | 102 | 126 | 109 | 135 | 117 | 144 | 125 | .572 |
| 27 | 105 | 89 | 113 | 96 | 121 | 103 | 130 | 111 | 139 | 118 | .617 |
| 28 | 102 | 85 | 109 | 91 | 117 | 98 | 126 | 105 | 134 | 112 | .664 |
| 29 | 98 | 80 | 106 | 87 | 113 | 93 | 121 | 99 | 130 | 107 | .712 |
| 30 | 95 | 76 | 102 | 82 | 109 | 88 | 117 | 94 | 125 | 101 | .762 |
| 32 | 89 | 69 | 96 | 74 | 102 | 79 | 110 | 85 | 117 | 91 | .867 |
| 34 | 84 | 63 | 90 | 67 | 96 | 72 | 104 | 78 | 110 | 82 | .979 |
| 36 | 79 | 56 | 85 | 61 | 91 | 65 | 98 | 70 | 104 | 75 | 1.10 |
| 38 | 75 | 52 | 81 | 56 | 86 | 59 | 93 | 64 | 99 | 68 | 1.22 |
| 40 | 71 | 47 | 77 | 51 | 82 | 54 | 88 | 58 | 94 | 62 | 1.35 |
| 42 | 68 | 43 | 73 | 46 | 78 | 50 | 84 | 53 | 89 | 57 | 1.49 |
| 44 | 65 | ... | 70 | ... | 75 | ... | 80 | ... | 86 | | 1.64 |
| 46 | 62 | ... | 67 | ... | 71 | ... | 76 | ... | 82 | | 1.79 |

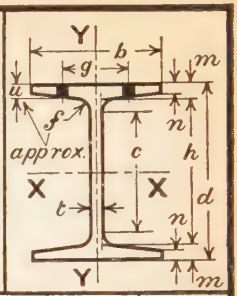
# 24" G

## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



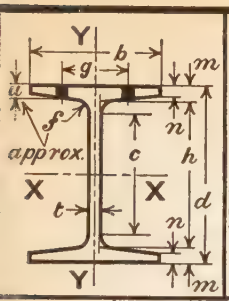

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth = d". | | 23.78 | 23.88 | 24.00 | 24.12 | 23.88 | 24.00 | 24.12 |
| Wt. per foot. | | 107.0 | 113.0 | 120.0 | 128.0 | 132.0 | 140.0 | 148.0 |
| Area. Sq. In.. | | 31.60 | 33.18 | 35.36 | 37.79 | 38.82 | 41.13 | 43.68 |
| b"..... | | 12.195 | 12.210 | 12.240 | 12.280 | 13.210 | 13.240 | 13.280 |
| t..... | | .485 | .500 | .530 | .570 | .570 | .600 | .640 |
| h..... | | 21.604 | 21.604 | 21.604 | 21.604 | 21.386 | 21.386 | 21.386 |
| m..... | | 1.088 | 1.138 | 1.198 | 1.258 | 1.247 | 1.307 | 1.367 |
| n..... | | .600 | .650 | .710 | .770 | .720 | .780 | .840 |
| f..... | | .65 | .65 | .65 | .65 | .70 | .70 | .70 |
| c..... | | 20.373 | 20.375 | 20.375 | 20.375 | 20.125 | 20.125 | 20.125 |
| g..... | | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ | 7½ |
| u..... | | 25/32 | 13/16 | 7/8 | 15/16 | 15/16 | 1" | 1 1/16 |
| AXES X-X | I.... | 3173.1 | 3363.3 | 3607.8 | 3867.1 | 3939.6 | 4201.3 | 4478.0 |
| | S.... | 266.87 | 281.68 | 300.65 | 320.66 | 329.95 | 350.11 | 371.31 |
| | r.... | 10.02 | 10.07 | 10.10 | 10.12 | 10.07 | 10.11 | 10.13 |
| AXES Y-Y | I.... | 220.0 | 236.1 | 256.3 | 277.5 | 329.9 | 355.6 | 382.5 |
| | S.... | 36.1 | 38.7 | 41.9 | 45.2 | 50.0 | 53.7 | 57.6 |
| | r.... | 2.64 | 2.67 | 2.69 | 2.71 | 2.92 | 2.94 | 2.96 |
| Coef. Str.... | | 3202500 | 3380200 | 3607800 | 3847900 | 3959300 | 4201300 | 4455700 |
| Max. Mom."# | | 4803700 | 5070300 | 5411700 | 5771800 | 5939000 | 6301900 | 6683600 |
| V..... | | 138400 | 143300 | 152600 | 165000 | 163300 | 172800 | 185200 |
| P. feet.. | | 11.57 | 11.79 | 11.82 | 11 66 | 12 12 | 12 16 | 12 03 |
| R..... | | 58800 | 61700 | 67500 | 75300 | 75200 | 81000 | 88800 |
| W..... | | 130980 | 135000 | 143160 | 143160 | 143160 | 143160 | 143160 |
| Q. feet.. | | 12 22 | 12.52 | 12 60 | 13.44 | 13.83 | 14.67 | 15.56 |
| w. lbs... | | 49 | 49 | 49 | 49 | 49 | 49 | 49 |
| Rivet dia.... | | 1" | 1" | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span | Laterally | | Laterally | | Laterally | | Laterally | | Laterally | | Laterally | | Laterally | | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| feet | fixed | free | fixed | free | fixed | free | fixed | free | fixed | free | fixed | free | fixed | free | |
| 10 | 277 | 277 | 287 | 287 | 305 | 305 | 330 | 330 | 327 | 327 | 346 | 346 | 370 | 370 | |
| 11 | 277 | 277 | 287 | 287 | 305 | 305 | 330 | 330 | 327 | 327 | 346 | 346 | 370 | 370 | |
| 12 | 267 | 267 | 282 | 282 | 301 | 301 | 321 | 321 | 327 | 327 | 346 | 346 | 370 | 370 | .112 |
| 13 | 246 | 246 | 260 | 260 | 278 | 278 | 296 | 296 | 305 | 305 | 323 | 323 | 343 | 343 | .131 |
| 14 | 229 | 229 | 241 | 241 | 258 | 258 | 275 | 275 | 283 | 283 | 300 | 300 | 318 | 318 | .152 |
| 15 | 214 | 214 | 225 | 225 | 241 | 241 | 257 | 257 | 264 | 264 | 280 | 280 | 297 | 297 | .175 |
| 16 | 200 | 198 | 211 | 209 | 225 | 223 | 240 | 238 | 247 | 247 | 263 | 263 | 278 | 278 | .199 |
| 17 | 188 | 183 | 199 | 194 | 212 | 207 | 226 | 221 | 233 | 231 | 247 | 245 | 262 | 260 | .225 |
| 18 | 178 | 170 | 188 | 181 | 200 | 192 | 214 | 206 | 220 | 215 | 233 | 229 | 248 | 243 | .251 |
| 19 | 169 | 160 | 178 | 168 | 190 | 180 | 203 | 192 | 208 | 201 | 221 | 214 | 235 | 227 | .280 |
| 20 | 160 | 149 | 169 | 157 | 180 | 168 | 192 | 179 | 198 | 189 | 210 | 200 | 223 | 213 | .310 |
| 21 | 153 | 140 | 161 | 148 | 172 | 158 | 183 | 168 | 189 | 178 | 200 | 188 | 212 | 200 | .342 |
| 22 | 146 | 132 | 154 | 139 | 164 | 148 | 175 | 158 | 180 | 167 | 191 | 177 | 203 | 188 | .375 |
| 23 | 139 | 123 | 147 | 130 | 157 | 139 | 167 | 148 | 172 | 157 | 183 | 167 | 194 | 177 | .411 |
| 24 | 133 | 116 | 141 | 123 | 150 | 131 | 160 | 139 | 165 | 148 | 175 | 157 | 186 | 167 | .447 |
| 25 | 128 | 109 | 135 | 115 | 144 | 123 | 154 | 132 | 158 | 140 | 168 | 148 | 178 | 158 | .485 |
| 26 | 123 | 103 | 130 | 109 | 139 | 117 | 148 | 124 | 152 | 132 | 162 | 141 | 171 | 149 | .525 |
| 27 | 119 | 98 | 125 | 103 | 134 | 110 | 143 | 118 | 147 | 126 | 156 | 133 | 165 | 141 | .566 |
| 28 | 114 | 92 | 121 | 98 | 129 | 104 | 137 | 111 | 141 | 118 | 150 | 126 | 159 | 134 | .608 |
| 29 | 110 | 87 | 117 | 92 | 124 | 98 | 133 | 106 | 137 | 113 | 145 | 120 | 154 | 127 | .653 |
| 30 | 107 | 83 | 113 | 87 | 120 | 93 | 128 | 100 | 132 | 107 | 140 | 114 | 149 | 121 | .698 |
| 32 | 100 | 74 | 106 | 79 | 113 | 84 | 120 | 89 | 124 | 97 | 131 | 102 | 139 | 109 | .795 |
| 34 | 94 | 67 | 99 | 71 | 106 | 76 | 113 | 81 | 116 | 87 | 124 | 93 | 131 | 99 | .897 |
| 36 | 89 | 61 | 94 | 64 | 100 | 68 | 107 | 73 | 110 | 80 | 117 | 85 | 124 | 90 | 1.01 |
| 38 | 84 | 55 | 89 | 58 | 95 | 62 | 101 | 66 | 104 | 72 | 111 | 77 | 117 | 82 | 1.12 |
| 40 | 80 | 50 | 85 | 53 | 90 | 57 | 96 | 60 | 99 | 66 | 105 | 70 | 111 | 75 | 1.24 |
| 42 | 76 | . | 80 | . | 86 | . | 92 | . | 94 | 60 | 100 | 64 | 106 | 68 | 1.37 |
| 44 | 73 | . | 77 | . | 82 | . | 87 | . | 90 | 56 | 95 | 59 | 101 | 63 | 1.50 |
| 46 | 70 | . | 73 | . | 78 | . | 84 | . | 86 | . | 91 | . | 97 | . | 1.64 |
| 48 | 67 | . | 70 | . | 75 | . | 80 | . | 82 | . | 88 | . | 93 | . | 1.79 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 26″ G

| | | | | | |
|---|---|---|---|---|---|
| Depth = d″. | | 25.81 | 25.88 | 26.00 | 26.12 |
| Wt. per foot. | | 138.0 | 144.0 | 151.0 | 160.0 |
| Area. Sq. In.. | | 40.65 | 42.38 | 44.55 | 47.25 |
| b″..... | | 13.700 | 13.730 | 13.750 | 13.790 |
| t..... | | .580 | .610 | .630 | .670 |
| h..... | | 23.336 | 23.336 | 23.336 | 23.336 |
| m..... | | 1.237 | 1.272 | 1.332 | 1.392 |
| n..... | | .690 | .725 | .785 | .845 |
| f..... | | .75 | .75 | .75 | .75 |
| c..... | | 22.0 | 22.0 | 22.0 | 22.0 |
| g..... | | 10″ | 10″ | 10″ | 10″ |
| u..... | | 27/32 | 7/8 | 31/32 | 1 1/32 |
| AXES | X-X I.... | 4779.9 | 4983.4 | 5289.8 | 5629.4 |
| | X-X S.... | 370.39 | 385.12 | 406.91 | 431.04 |
| | X-X r.... | 10.84 | 10.84 | 10.90 | 10.92 |
| | Y-Y I.... | 357.4 | 375.0 | 402.8 | 432.8 |
| | Y-Y S.... | 52.2 | 54.6 | 58.6 | 62.8 |
| | Y-Y r.... | 2.97 | 2.97 | 3.01 | 3.03 |
| Coef. Str.... | | 4444700 | 4621400 | 4882900 | 5172500 |
| Max. Mom.″/# | | 6667000 | 6932100 | 7324300 | 7758700 |
| V..... | | 179600 | 189400 | 196600 | 210000 |
| P. feet.. | | 12.37 | 12.20 | 12.42 | 12.32 |
| R..... | | 78500 | 84300 | 88300 | 96400 |
| W..... | | 167000 | 167000 | 167000 | 167000 |
| Q. feet.. | | 13.31 | 13.84 | 14.62 | 15.49 |
| w. lbs... | | 58 | 58 | 58 | 58 |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 359 | 359 | 379 | 379 | 393 | 393 | 420 | 420 | |
| 12 | 359 | 359 | 379 | 379 | 393 | 393 | 420 | 420 | |
| 13 | 342 | 342 | 355 | 355 | 376 | 376 | 398 | 398 | .121 |
| 14 | 317 | 317 | 330 | 330 | 349 | 349 | 369 | 369 | .140 |
| 15 | 296 | 296 | 308 | 308 | 326 | 326 | 345 | 345 | .161 |
| 16 | 278 | 278 | 289 | 289 | 305 | 305 | 323 | 323 | .183 |
| 17 | 261 | 261 | 272 | 272 | 287 | 287 | 304 | 304 | .207 |
| 18 | 247 | 244 | 257 | 254 | 271 | 268 | 287 | 284 | .232 |
| 19 | 234 | 229 | 243 | 237 | 257 | 251 | 272 | 266 | .258 |
| 20 | 222 | 214 | 231 | 223 | 244 | 235 | 259 | 250 | .287 |
| 21 | 212 | 201 | 220 | 209 | 233 | 222 | 246 | 234 | .316 |
| 22 | 202 | 189 | 210 | 197 | 222 | 208 | 235 | 221 | .347 |
| 23 | 193 | 178 | 201 | 186 | 212 | 196 | 225 | 208 | .379 |
| 24 | 185 | 168 | 193 | 176 | 203 | 185 | 215 | 196 | .413 |
| 25 | 178 | 160 | 185 | 166 | 195 | 175 | 207 | 186 | .448 |
| 26 | 171 | 151 | 178 | 157 | 188 | 166 | 199 | 176 | .484 |
| 27 | 165 | 143 | 171 | 149 | 181 | 157 | 192 | 167 | .522 |
| 28 | 159 | 136 | 165 | 141 | 174 | 149 | 185 | 158 | .562 |
| 29 | 153 | 129 | 159 | 134 | 168 | 141 | 178 | 150 | .602 |
| 30 | 148 | 122 | 154 | 127 | 163 | 135 | 172 | 143 | .645 |
| 32 | 139 | 111 | 144 | 115 | 153 | 122 | 162 | 130 | .733 |
| 34 | 131 | 101 | 136 | 105 | 144 | 111 | 152 | 117 | .832 |
| 36 | 124 | 92 | 128 | 95 | 136 | 101 | 144 | 107 | .928 |
| 38 | 117 | 84 | 122 | 87 | 128 | 92 | 136 | 98 | 1.03 |
| 40 | 111 | 76 | 116 | 80 | 122 | 84 | 129 | 89 | 1.15 |
| 42 | 106 | ... | 110 | 73 | 116 | 77 | 123 | 82 | 1.26 |
| 44 | 101 | ... | 105 | 67 | 111 | 71 | 118 | 76 | 1.39 |
| 46 | 97 | ... | 100 | ... | 106 | ... | 112 | ... | 1.52 |
| 48 | 93 | ... | 96 | ... | 102 | ... | 108 | ... | 1.65 |
| 50 | 89 | ... | 92 | ... | 98 | ... | 103 | ... | 1.79 |

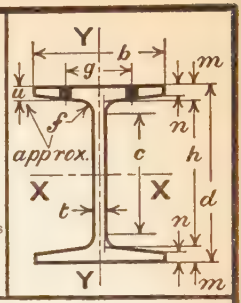
# 28″ G

# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



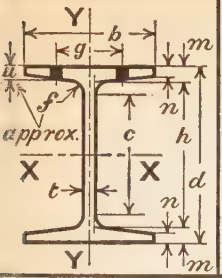

| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d″. | | 27.75 | 27.88 | 28.00 | 28.12 | 28.31 |
| Wt. per foot. | | 145.0 | 156.0 | 165.0 | 175.0 | 186.0 |
| Area. Sq. In.. | | 42.69 | 45.93 | 48.75 | 51.45 | 54.73 |
| b″..... | | 14.160 | 14.210 | 14.250 | 14.285 | 14.305 |
| t..... | | .585 | .635 | .675 | .710 | .730 |
| h..... | | 25.268 | 25.268 | 25.268 | 25.268 | 25.268 |
| m..... | | 1.241 | 1.306 | 1.366 | 1.426 | 1.521 |
| n..... | | .675 | .740 | .800 | .860 | .955 |
| f..... | | .80 | .80 | .80 | .80 | .80 |
| c..... | | 23.750 | 23.750 | 23.750 | 23.750 | 23.750 |
| g..... | | 10″ | 10″ | 10″ | 10″ | 10″ |
| u..... | | 27/32 | 29/32 | 31/32 | 1 1/32 | 1 1/8 |
| AXES X-X | I.... | 5772.3 | 6218.6 | 6624.6 | 7026.0 | 7604.0 |
| | S.... | 416.02 | 446.10 | 473.19 | 499.72 | 537.20 |
| | r.... | 11.63 | 11.64 | 11.66 | 11.69 | 11.79 |
| AXES Y-Y | I.... | 389.8 | 425.4 | 458.3 | 491.1 | 539.7 |
| | S.... | 55.1 | 59.9 | 64.3 | 68.8 | 75.5 |
| | r.... | 3.02 | 3.04 | 3.07 | 3.09 | 3.14 |
| Coef. Str.... | | 4992300 | 5353200 | 5678200 | 5996600 | 6446300 |
| Max. Mom. ″# | | 7488400 | 8029700 | 8517300 | 8994900 | 9669500 |
| V..... | | 194800 | 212400 | 226800 | 239600 | 248000 |
| P. feet.. | | 12.81 | 12.60 | 12.52 | 12.51 | 13.00 |
| R..... | | 80000 | 90600 | 99100 | 106700 | 111100 |
| W..... | | 167000 | 167000 | 167000 | 167000 | 167000 |
| Q. feet.. | | 14.95 | 16.03 | 17.00 | 17.95 | 19.30 |
| w. lbs... | | 58 | 58 | 58 | 58 | 58 |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 390 | 390 | 425 | 425 | 454 | 454 | 479 | 479 | 496 | 496 | |
| 13 | 384 | 384 | 412 | 412 | 437 | 437 | 461 | 461 | 496 | 496 | .113 |
| 14 | 357 | 357 | 382 | 382 | 406 | 406 | 428 | 428 | 460 | 460 | .123 |
| 15 | 333 | 333 | 357 | 357 | 379 | 379 | 400 | 400 | 430 | 430 | .150 |
| 16 | 312 | 312 | 335 | 335 | 355 | 355 | 375 | 375 | 403 | 403 | .170 |
| 17 | 294 | 294 | 315 | 315 | 334 | 334 | 353 | 353 | 379 | 379 | .193 |
| 18 | 277 | 276 | 297 | 296 | 315 | 314 | 333 | 332 | 358 | 357 | .215 |
| 19 | 263 | 259 | 282 | 278 | 299 | 295 | 316 | 311 | 339 | 334 | .240 |
| 20 | 250 | 243 | 268 | 261 | 284 | 277 | 300 | 292 | 322 | 314 | .266 |
| 21 | 238 | 228 | 255 | 245 | 270 | 259 | 286 | 275 | 307 | 295 | .293 |
| 22 | 227 | 215 | 243 | 230 | 258 | 245 | 273 | 259 | 293 | 278 | .322 |
| 23 | 217 | 203 | 233 | 218 | 247 | 231 | 261 | 244 | 280 | 262 | .352 |
| 24 | 208 | 192 | 223 | 205 | 237 | 219 | 250 | 231 | 269 | 249 | .383 |
| 25 | 200 | 181 | 214 | 194 | 227 | 206 | 240 | 218 | 258 | 235 | .416 |
| 26 | 192 | 172 | 206 | 184 | 218 | 195 | 231 | 207 | 248 | 223 | .450 |
| 27 | 185 | 163 | 198 | 175 | 210 | 186 | 222 | 196 | 239 | 212 | .485 |
| 28 | 178 | 154 | 191 | 166 | 203 | 176 | 214 | 186 | 230 | 200 | .521 |
| 29 | 172 | 147 | 185 | 158 | 196 | 168 | 207 | 177 | 222 | 190 | .559 |
| 30 | 166 | 139 | 178 | 150 | 189 | 159 | 200 | 169 | 215 | 181 | .599 |
| 32 | 156 | 127 | 167 | 136 | 177 | 144 | 187 | 153 | 201 | 164 | .681 |
| 34 | 147 | 115 | 157 | 124 | 167 | 132 | 176 | 139 | 190 | 150 | .769 |
| 36 | 139 | 105 | 149 | 113 | 158 | 120 | 167 | 127 | 179 | 137 | .862 |
| 38 | 131 | 96 | 141 | 103 | 149 | 109 | 158 | 116 | 170 | 125 | .960 |
| 40 | 125 | 88 | 134 | 95 | 142 | 101 | 150 | 107 | 161 | 114 | 1.06 |
| 42 | 119 | 81 | 127 | 87 | 135 | 92 | 143 | 98 | 154 | 106 | 1.17 |
| 44 | 113 | 74 | 122 | 80 | 129 | 85 | 136 | 90 | 147 | 97 | 1.29 |
| 46 | 109 | 69 | 116 | 74 | 123 | 78 | 130 | 83 | 140 | 89 | 1.40 |
| 48 | 104 | ... | 112 | ... | 118 | ... | 125 | ... | 134 | | 1.53 |
| 50 | 100 | ... | 107 | ... | 114 | ... | 120 | ... | 129 | | 1.66 |
| 52 | 96 | ... | 103 | ... | 109 | ... | 115 | ... | 124 | | 1.80 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 30″ G

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d″. | | 29.88 | 30.00 | 30.12 | 30.25 | 30.50 | 30.75 |
| Wt. per foot. | | 173.0 | 180.0 | 190.0 | 200.0 | 220.0 | 240.0 |
| Area. Sq. In.. | | 50.80 | 53.20 | 55.90 | 58.92 | 64.82 | 70.60 |
| b″..... | | 14.980 | 15.000 | 15.030 | 15.065 | 15.135 | 15.200 |
| t..... | | .660 | .680 | .710 | .745 | .815 | .880 |
| h..... | | 27.148 | 27.148 | 27.148 | 27.148 | 27.148 | 27.148 |
| m..... | | 1.366 | 1.426 | 1.486 | 1.551 | 1.676 | 1.801 |
| n..... | | .769 | .829 | .889 | .954 | 1.079 | 1.204 |
| f..... | | .85 | .85 | .85 | .85 | .85 | .85 |
| c..... | | 25.50 | 25.50 | 25.50 | 25.50 | 25.50 | 25.50 |
| g..... | | 10″ | 10″ | 10″ | 10″ | 10″ | 10″ |
| u..... | | 31/32 | 11/32 | 13/32 | 15/32 | 1 9/32 | 1 13/32 |
| AXES X-X | I.... | 7895.2 | 8343.1 | 8818.0 | 9343.8 | 10378.0 | 11423.0 |
| | S.... | 528.46 | 556.21 | 585.52 | 617.77 | 680.52 | 742.96 |
| | r.... | 12.47 | 12.52 | 12.56 | 12.59 | 12.65 | 12.72 |
| AXES Y-Y | I.... | 519.1 | 555.1 | 592.7 | 634.2 | 716.1 | 799.2 |
| | S.... | 69.3 | 74.0 | 78.9 | 84.2 | 94.6 | 105.2 |
| | r.... | 3.20 | 3.23 | 3.26 | 3.28 | 3.32 | 3.36 |
| Coef. Str.... | | 6341500 | 6674500 | 7026300 | 7413300 | 8166300 | 8915500 |
| Max. Mom. ″/# | | 9512300 | 10011700 | 10539400 | 11119900 | 12249400 | 13373300 |
| V..... | | 236600 | 244800 | 256600 | 270400 | 298300 | 324700 |
| P. feet.. | | 13.40 | 13.63 | 13.69 | 13.71 | 13.69 | 13.73 |
| R..... | | 97200 | 101600 | 108400 | 116400 | 132300 | 147200 |
| W..... | | 190880 | 190880 | 190880 | 190880 | 190880 | 190880 |
| Q. feet.. | | 16.61 | 17.48 | 18.40 | 19.42 | 21.39 | 23.35 |
| w. lbs... | | 66 | 66 | 66 | 66 | 66 | 66 |
| Rivet dia.... | | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.

For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

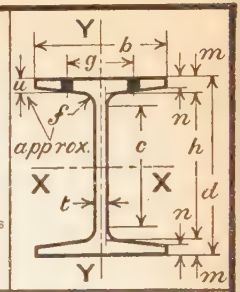
| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 473 | 473 | 490 | 490 | 513 | 513 | 541 | 541 | 597 | 597 | 649 | 649 | |
| 14 | 453 | 453 | 477 | 477 | 502 | 502 | 530 | 530 | 583 | 583 | 636 | 636 | .122 |
| 15 | 423 | 423 | 445 | 445 | 468 | 468 | 494 | 494 | 544 | 544 | 594 | 594 | .140 |
| 16 | 396 | 396 | 417 | 417 | 439 | 439 | 463 | 463 | 510 | 510 | 557 | 557 | .159 |
| 17 | 373 | 373 | 393 | 393 | 413 | 413 | 436 | 436 | 480 | 480 | 524 | 524 | .180 |
| 18 | 352 | 352 | 371 | 371 | 390 | 390 | 412 | 412 | 454 | 454 | 495 | 495 | .201 |
| 19 | 334 | 333 | 351 | 350 | 370 | 369 | 390 | 389 | 430 | 429 | 469 | 468 | .224 |
| 20 | 317 | 312 | 334 | 329 | 351 | 346 | 371 | 366 | 408 | 402 | 446 | 441 | .248 |
| 21 | 302 | 294 | 318 | 310 | 335 | 326 | 353 | 344 | 389 | 379 | 425 | 415 | .274 |
| 22 | 288 | 277 | 303 | 292 | 319 | 307 | 337 | 325 | 371 | 358 | 405 | 391 | .300 |
| 23 | 276 | 262 | 290 | 276 | 305 | 290 | 322 | 306 | 355 | 338 | 388 | 370 | .329 |
| 24 | 264 | 248 | 278 | 261 | 293 | 275 | 309 | 290 | 340 | 320 | 372 | 351 | .358 |
| 25 | 254 | 235 | 267 | 247 | 281 | 260 | 297 | 275 | 327 | 304 | 357 | 332 | .388 |
| 26 | 244 | 223 | 257 | 235 | 270 | 247 | 285 | 261 | 314 | 288 | 343 | 315 | .420 |
| 27 | 235 | 212 | 247 | 223 | 260 | 234 | 275 | 248 | 302 | 273 | 330 | 299 | .452 |
| 28 | 226 | 201 | 238 | 211 | 251 | 223 | 265 | 236 | 292 | 260 | 318 | 284 | .487 |
| 29 | 219 | 192 | 230 | 201 | 242 | 212 | 256 | 225 | 282 | 248 | 307 | 270 | .522 |
| 30 | 211 | 182 | 222 | 192 | 234 | 202 | 247 | 213 | 272 | 236 | 297 | 258 | .559 |
| 32 | 198 | 166 | 209 | 175 | 220 | 184 | 232 | 195 | 255 | 214 | 279 | 235 | .636 |
| 34 | 187 | 152 | 196 | 159 | 207 | 168 | 218 | 177 | 240 | 195 | 262 | 214 | .718 |
| 36 | 176 | 138 | 185 | 145 | 195 | 153 | 206 | 162 | 227 | 179 | 248 | 196 | .804 |
| 38 | 167 | 127 | 176 | 134 | 185 | 141 | 195 | 148 | 215 | 164 | 235 | 180 | .896 |
| 40 | 159 | 117 | 167 | 123 | 176 | 130 | 185 | 136 | 204 | 151 | 223 | 165 | .993 |
| 42 | 151 | 107 | 159 | 113 | 167 | 119 | 177 | 126 | 194 | 139 | 212 | 152 | 1.10 |
| 44 | 144 | 99 | 152 | 104 | 160 | 110 | 168 | 116 | 186 | 128 | 203 | 141 | 1.20 |
| 46 | 138 | 91 | 145 | 96 | 153 | 102 | 161 | 107 | 178 | 119 | 194 | 130 | 1.31 |
| 48 | 132 | 84 | 139 | 89 | 146 | 94 | 154 | 99 | 170 | 110 | 186 | 120 | 1.43 |
| 50 | 127 | ... | 133 | 78 | 141 | 87 | 148 | 92 | 163 | 102 | 178 | 111 | 1.55 |
| 52 | 122 | ... | 128 | ... | 135 | ... | 143 | ... | 157 | ... | 171 | ... | 1.68 |
| 54 | 117 | ... | 124 | ... | 130 | ... | 137 | ... | 151 | ... | 165 | ... | 1.81 |

# 33" G

## BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



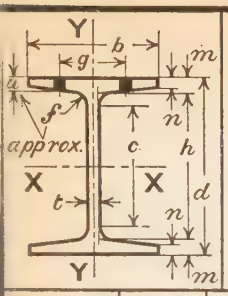

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d" | | 32.88 | 33.00 | 33.12 | 33.25 | 33.44 | 33.63 |
| Wt. per foot | | 200.0 | 210.0 | 220.0 | 230.0 | 245.0 | 260.0 |
| Area Sq. In. | | 58.87 | 61.91 | 64 80 | 67.85 | 72.19 | 76.54 |
| b" | | 15.715 | 15.750 | 15.780 | 15.810 | 15.850 | 15.890 |
| t | | .700 | .735 | .765 | .795 | .835 | .875 |
| h | | 29.904 | 29.904 | 29.904 | 29.904 | 29.904 | 29.904 |
| m | | 1.488 | 1.548 | 1.608 | 1.673 | 1.768 | 1.863 |
| n | | .862 | .922 | .982 | 1.047 | 1.142 | 1.237 |
| f | | .90 | .90 | .90 | .90 | .90 | .90 |
| c | | 28.250 | 28.250 | 28.250 | 28.250 | 28.250 | 28.250 |
| g | | 10" | 10" | 10" | 10" | 10" | 10" |
| u | | 13/32 | 15/32 | 17/32 | 19/32 | 1⅜ | 115/32 |
| AXES X-X | I | 11055 | 11671 | 12278 | 12935 | 13895 | 14868 |
| | S | 672.45 | 707.33 | 741.43 | 778.05 | 831.04 | 884.21 |
| | r | 13.70 | 13.73 | 13.77 | 13.81 | 13.87 | 13.94 |
| AXES Y-Y | I | 664.6 | 708.5 | 752.2 | 799.6 | 869.2 | 939.8 |
| | S | 84.6 | 90.0 | 95.3 | 101.2 | 109.7 | 118.3 |
| | r | 3.36 | 3.38 | 3.41 | 3.43 | 3.47 | 3.50 |
| Coef. Str. | | 8069300 | 8488000 | 8897100 | 9336500 | 9972500 | 10610500 |
| Max. Mom."# | | 12104000 | 12732000 | 13345700 | 14004800 | 14958700 | 15915800 |
| V | | 276200 | 291100 | 304000 | 317200 | 335100 | 353100 |
| P. feet | | 14.61 | 14.58 | 14.63 | 14.72 | 14.87 | 15 02 |
| R | | 108000 | 116300 | 123600 | 130900 | 140700 | 150500 |
| W | | 190880 | 190880 | 190880 | 190880 | 190880 | 190880 |
| Q. feet | | 21.14 | 22.23 | 23 31 | 24.46 | 26 12 | 27 79 |
| w. lbs | | 66 | 66 | 66 | 66 | 66 | 66 |
| Rivet dia | | 1" | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 552 | 552 | 582 | 582 | 608 | 608 | 634 | 634 | 670 | 670 | 706 | 706 | .111 |
| 16 | 504 | 504 | 531 | 531 | 556 | 556 | 584 | 584 | 623 | 623 | 663 | 663 | .144 |
| 18 | 448 | 448 | 472 | 472 | 494 | 494 | 519 | 519 | 554 | 554 | 589 | 589 | .183 |
| 20 | 403 | 401 | 424 | 422 | 445 | 443 | 467 | 465 | 499 | 498 | 531 | 530 | .226 |
| 21 | 384 | 378 | 404 | 398 | 424 | 418 | 445 | 439 | 475 | 469 | 505 | 497 | .249 |
| 22 | 367 | 357 | 386 | 376 | 404 | 394 | 424 | 413 | 453 | 442 | 482 | 468 | .273 |
| 23 | 351 | 338 | 369 | 355 | 387 | 373 | 406 | 391 | 434 | 419 | 461 | 445 | .298 |
| 24 | 336 | 320 | 354 | 337 | 371 | 353 | 389 | 371 | 416 | 397 | 442 | 422 | .325 |
| 25 | 323 | 304 | 340 | 320 | 356 | 335 | 373 | 351 | 399 | 376 | 424 | 398 | .353 |
| 26 | 310 | 288 | 326 | 303 | 342 | 318 | 359 | 334 | 384 | 357 | 408 | 380 | .381 |
| 27 | 299 | 274 | 314 | 288 | 330 | 303 | 346 | 318 | 369 | 339 | 393 | 361 | 411 |
| 28 | 288 | 260 | 303 | 274 | 318 | 288 | 333 | 302 | 356 | 323 | 379 | 344 | 442 |
| 29 | 278 | 248 | 293 | 262 | 307 | 275 | 322 | 288 | 344 | 307 | 366 | 328 | 475 |
| 30 | 269 | 237 | 283 | 249 | 297 | 262 | 311 | 274 | 332 | 293 | 354 | 313 | 508 |
| 31 | 260 | 226 | 274 | 238 | 287 | 250 | 301 | 262 | 322 | 280 | 342 | 298 | 542 |
| 32 | 252 | 216 | 265 | 227 | 278 | 238 | 292 | 250 | 312 | 268 | 332 | 285 | .578 |
| 33 | 245 | 207 | 257 | 217 | 270 | 228 | 283 | 239 | 302 | 255 | 322 | 273 | .614 |
| 34 | 237 | 196 | 250 | 208 | 262 | 218 | 275 | 229 | 293 | 243 | 312 | 261 | 652 |
| 35 | 231 | 189 | 243 | 199 | 254 | 208 | 267 | 219 | 285 | 234 | 303 | 250 | .691 |
| 36 | 224 | 181 | 236 | 191 | 247 | 200 | 259 | 209 | 277 | 224 | 295 | 239 | 731 |
| 38 | 212 | 166 | 223 | 175 | 234 | 184 | 246 | 193 | 262 | 206 | 279 | 220 | .815 |
| 40 | 202 | 153 | 212 | 161 | 222 | 169 | 233 | 177 | 249 | 190 | 265 | 202 | .903 |
| 42 | 192 | 141 | 202 | 149 | 212 | 156 | 222 | 163 | 237 | 175 | 253 | 186 | .995 |
| 44 | 183 | 130 | 193 | 137 | 202 | 144 | 212 | 151 | 227 | 162 | 241 | 173 | 1.09 |
| 46 | 175 | 120 | 185 | 127 | 193 | 133 | 203 | 140 | 217 | 150 | 231 | 160 | 1 19 |
| 48 | 168 | 112 | 177 | 118 | 185 | 123 | 195 | 130 | 208 | 139 | 221 | 148 | 1.30 |
| 50 | 161 | 103 | 170 | 109 | 178 | 115 | 187 | 121 | 199 | 128 | 212 | 137 | 1.41 |
| 52 | 155 | 96 | 163 | 101 | 171 | 107 | 180 | 112 | 192 | 120 | 204 | 128 | 1.53 |
| 54 | 149 | . | 157 | . | 165 | . | 173 | .. | 185 | . | 197 | .. | 1.65 |
| 56 | 144 | . | 152 | . | 159 | . | 167 | .. | 178 | . | 189 | .. | 1.77 |




# BETHLEHEM GIRDER BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration

V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 36" G

| | | 35.88 | 36.00 | 36.12 | 36.24 | 36.50 | 36.72 |
|---|---|---|---|---|---|---|---|
| Depth = d". | | | | | | | |
| Wt. per foot. | | 230.0 | 240.0 | 250.0 | 260.0 | 280.0 | 300.0 |
| Area Sq.In. | | 67.67 | 70.55 | 73.61 | 76.50 | 82.45 | 88.12 |
| b" | | 16.475 | 16.500 | 16.530 | 16.555 | 16.600 | 16.655 |
| t | | .765 | .790 | .820 | .845 | .890 | .945 |
| h | | 32.706 | 32.706 | 32.706 | 32.706 | 32.706 | 32.706 |
| m | | 1.587 | 1.647 | 1.707 | 1.767 | 1.897 | 2.007 |
| n | | .933 | .993 | 1.053 | 1.113 | 1.243 | 1.353 |
| f | | .95 | .95 | .95 | .95 | .95 | .95 |
| c | | 31.000 | 31.000 | 31.000 | 31.000 | 31.000 | 31.000 |
| g | | 10" | 10" | 10" | 10" | 10" | 10" |
| u | | 1 3/16 | 1 1/4 | 1 5/16 | 1 3/8 | 1 1/2 | 1 5/8 |
| AXES X-X | I | 14960 | 15696 | 16457 | 17205 | 18811 | 20262 |
| | S | 833.89 | 872.00 | 911.24 | 949.50 | 1030.74 | 1103.59 |
| | r | 14.87 | 14.92 | 14.95 | 15.00 | 15.10 | 15.16 |
| AXES Y-Y | I | 824.5 | 873.5 | 923.8 | 973.7 | 1081.4 | 1177.7 |
| | S | 100.1 | 105.9 | 111.8 | 117.6 | 130.3 | 141.4 |
| | r | 3.49 | 3.52 | 3.54 | 3.57 | 3.62 | 3.66 |
| Coef. Str. | | 10006700 | 10464000 | 10934900 | 11394000 | 12368900 | 13243100 |
| Max. Mom."# | | 15010000 | 15696000 | 16402300 | 17091100 | 18553300 | 19864700 |
| V | | 329400 | 341300 | 355400 | 367500 | 389800 | 416400 |
| P. feet | | 15.19 | 15.33 | 15.38 | 15.50 | 15.87 | 15.90 |
| R | | 125600 | 132000 | 139700 | 146000 | 158000 | 172300 |
| W | | 190880 | 190880 | 190880 | 190880 | 190880 | 190880 |
| Q. feet | | 26.21 | 27.41 | 28.64 | 29.85 | 32.40 | 34.69 |
| w. lbs. | | 66 | 66 | 66 | 66 | 66 | 66 |
| Rivet dia. | | 1" | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 625 | 625 | 654 | 654 | 683 | 683 | 712 | 712 | 773 | 773 | 828 | 828 | .132 |
| 18 | 556 | 556 | 581 | 581 | 607 | 607 | 633 | 633 | 687 | 687 | 736 | 736 | .167 |
| 20 | 500 | 500 | 523 | 523 | 547 | 547 | 570 | 570 | 618 | 618 | 662 | 662 | .207 |
| 21 | 477 | 474 | 498 | 496 | 521 | 519 | 542 | 540 | 589 | 587 | 631 | 629 | .228 |
| 22 | 455 | 448 | 476 | 469 | 497 | 490 | 518 | 511 | 562 | 554 | 602 | 594 | .250 |
| 23 | 435 | 424 | 455 | 444 | 475 | 463 | 495 | 483 | 538 | 525 | 576 | 562 | .273 |
| 24 | 417 | 402 | 436 | 420 | 455 | 439 | 475 | 458 | 515 | 498 | 552 | 534 | .298 |
| 25 | 400 | 381 | 418 | 399 | 437 | 417 | 456 | 435 | 495 | 473 | 530 | 507 | .323 |
| 26 | 385 | 363 | 402 | 379 | 420 | 396 | 438 | 413 | 476 | 449 | 509 | 481 | .350 |
| 27 | 371 | 345 | 387 | 360 | 405 | 377 | 422 | 394 | 458 | 428 | 490 | 457 | .377 |
| 28 | 358 | 329 | 374 | 344 | 390 | 359 | 407 | 375 | 442 | 408 | 473 | 436 | .406 |
| 29 | 345 | 314 | 361 | 328 | 377 | 343 | 393 | 358 | 427 | 389 | 457 | 417 | .435 |
| 30 | 334 | 299 | 349 | 313 | 364 | 327 | 380 | 342 | 412 | 371 | 441 | 397 | .466 |
| 31 | 323 | 286 | 337 | 299 | 353 | 313 | 367 | 326 | 399 | 354 | 427 | 380 | .497 |
| 32 | 313 | 274 | 327 | 286 | 342 | 299 | 356 | 312 | 387 | 339 | 414 | 363 | .530 |
| 33 | 303 | 261 | 317 | 273 | 331 | 286 | 345 | 298 | 375 | 323 | 401 | 347 | .563 |
| 34 | 294 | 250 | 308 | 262 | 322 | 274 | 335 | 285 | 364 | 310 | 389 | 332 | .598 |
| 35 | 286 | 240 | 299 | 251 | 312 | 262 | 325 | 273 | 353 | 297 | 378 | 319 | .634 |
| 36 | 278 | 230 | 291 | 241 | 304 | 252 | 316 | 262 | 344 | 286 | 368 | 306 | .670 |
| 38 | 263 | 211 | 275 | 221 | 288 | 232 | 300 | 242 | 326 | 263 | 348 | 281 | .747 |
| 40 | 250 | 195 | 262 | 205 | 273 | 213 | 285 | 223 | 309 | 242 | 331 | 260 | .828 |
| 42 | 238 | 180 | 249 | 189 | 260 | 197 | 271 | 206 | 295 | 224 | 315 | 240 | .912 |
| 44 | 228 | 168 | 238 | 175 | 248 | 182 | 259 | 191 | 281 | 206 | 301 | 223 | 1.001 |
| 46 | 218 | 155 | 227 | 162 | 238 | 170 | 248 | 177 | 269 | 192 | 288 | 208 | 1.094 |
| 48 | 209 | 144 | 218 | 150 | 228 | 158 | 237 | 164 | 258 | 179 | 276 | 192 | 1.191 |
| 50 | 200 | 134 | 209 | 140 | 219 | 147 | 228 | 153 | 247 | 166 | 265 | 179 | 1.293 |
| 52 | 193 | 125 | 201 | 130 | 210 | 136 | 219 | 142 | 238 | 155 | 255 | 167 | 1.399 |
| 54 | 185 | 116 | 194 | 122 | 202 | 127 | 211 | 133 | 229 | 144 | 245 | 155 | 1.508 |
| 56 | 179 | ... | 187 | ... | 195 | . | 203 | .. | 221 | . | 236 | . | 1.622 |
| 58 | 173 | . | 180 | . | 189 | . | 196 | . | 213 | . | 228 | . | 1.740 |

# ALLOWABLE END REACTIONS FOR BETHLEHEM GIRDER BEAMS
## DETERMINED BY
# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per foot | Web t | Unit Stress in Buckling | Reaction R for 3½" Bearing | Min. Span for 3½" Bearing | Reaction R for 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V | Length of Bearing to develop V |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 29.5 | .285" | 15000 | 23400 | 6.55' | 32000 | 4280 | 26900 | 4.32" |
| | 33.0 | .290 | 15000 | 23900 | 7.29 | 32600 | 4350 | 27800 | 4.39 |
| | 36.5 | .310 | 15000 | 25700 | 7.62 | 35000 | 4650 | 30200 | 4.46 |
| 9 | 36.0 | .290 | 15000 | 25000 | 8.62 | 31100 | 4350 | 31100 | 4.90 |
| | 38.5 | .310 | 15000 | 26700 | 8.58 | 33500 | 4650 | 33500 | 4.96 |
| | 43.5 | .350 | 15000 | 30200 | 8 50 | 38300 | 5260 | 38300 | 5.05 |
| 10 | 41.5 | .310 | 15000 | 27900 | 9 81 | 36900 | 4650 | 36900 | 5.44 |
| | 44.5 | .320 | 15000 | 28800 | 10 27 | 38400 | 4800 | 38400 | 5.50 |
| | 50.0 | .360 | 15000 | 32400 | 10.15 | 43200 | 5400 | 43700 | 5.60 |
| 12 | 51.5 | .360 | 15000 | 35100 | 11.50 | 45900 | 5400 | 51500 | 6.54 |
| | 55.5 | .380 | 15000 | 37100 | 11.74 | 48500 | 5700 | 54700 | 6.60 |
| | 61.0 | .410 | 15000 | 40000 | 11.97 | 52300 | 6150 | 59700 | 6.70 |
| | 66.0 | .450 | 15000 | 43900 | 11 44 | 57400 | 6750 | 64100 | 6.49 |
| | 70.5 | .470 | 15000 | 45800 | 11.87 | 59900 | 7050 | 67700 | 6.60 |
| | 76.5 | .510 | 15000 | 49700 | 11.84 | 65000 | 7650 | 74200 | 6.70 |
| 15 | 64.5 | .390 | 14510 | 41000 | 15.24 | 52400 | 5660 | 69400 | 8.51 |
| | 69.0 | .420 | 14850 | 45200 | 14.55 | 57700 | 6240 | 75000 | 8.27 |
| | 74.0 | .440 | 15000 | 47900 | 14.91 | 61100 | 6600 | 79200 | 8.25 |
| | 80.5 | .480 | 15000 | 52200 | 14.86 | 66600 | 7200 | 87100 | 8.35 |
| | 94.0 | .540 | 15000 | 58700 | 15.06 | 74900 | 8100 | 95900 | 8.09 |
| | 99.0 | .570 | 15000 | 62000 | 14.93 | 79100 | 8550 | 101700 | 8.15 |
| | 105.0 | .600 | 15000 | 65300 | 15.09 | 83300 | 9000 | 108000 | 8.25 |
| | 111.0 | .640 | 15000 | 69600 | 15.04 | 88800 | 9600 | 116200 | 8.35 |
| | 127.0 | .730 | 15000 | 79400 | 14.51 | 101300 | 10950 | 129200 | 8.05 |
| | 135.0 | .770 | 15000 | 83700 | 14.54 | 106800 | 11550 | 137400 | 8.15 |
| | 141.0 | .800 | 15000 | 87000 | 14.68 | 111000 | 12000 | 144000 | 8.25 |
| | 147.0 | .830 | 15000 | 90300 | 14.81 | 115200 | 12450 | 150600 | 8.34 |
| 16 | 74 5 | .390 | 14100 | 41300 | 18 91 | 52300 | 5500 | 74300 | 9.49 |
| | 81.0 | .420 | 14490 | 45700 | 18.57 | 57800 | 6090 | 80600 | 9.23 |
| | 87.0 | .450 | 14830 | 50000 | 18.32 | 63400 | 6670 | 87000 | 9.04 |
| | 94.0 | .485 | 15000 | 54600 | 18.14 | 69100 | 7280 | 94600 | 8.99 |
| 18 | 80.0 | .420 | 13820 | 46200 | 20.06 | 57800 | 5800 | 90100 | 11.06 |
| | 86 0 | .440 | 14070 | 49500 | 20.25 | 61900 | 6190 | 95000 | 10.85 |
| | 92.0 | .460 | 14300 | 52800 | 20.43 | 66000 | 6580 | 100000 | 10.67 |
| | 99.0 | .485 | 14560 | 56900 | 20.43 | 71000 | 7060 | 106200 | 10.48 |

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

# ALLOWABLE END REACTIONS FOR BETHLEHEM GIRDER BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per foot | Web t | Unit Stress in Buckling | Reaction R for 3 ½″ Bearing | Min. Span for 3 ½″ Bearing | Reaction R for 5 ½″ Bearing | Increase in R for 1″ Additional Bearing | Max. Web Shear V | Length of Bearing to develop V |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 99.0 | .510 | 14400 | 62400 | 19.81′ | 77100 | 7340 | 120900 | 11.47″ |
| | 107.0 | .540 | 14650 | 67200 | 19.82 | 83000 | 7910 | 128800 | 11.28 |
| | 113.0 | .560 | 14850 | 70700 | 20.05 | 87300 | 8320 | 134400 | 11.16 |
| | 120.0 | .590 | 15000 | 75200 | 20.05 | 92900 | 8850 | 142500 | 11.10 |
| | 127.0 | .600 | 15000 | 76500 | 20.71 | 94500 | 9000 | 142200 | 10.80 |
| | 135.0 | .630 | 15000 | 80300 | 20.97 | 99200 | 9450 | 150300 | 10.90 |
| | 142.0 | .660 | 15000 | 84200 | 21.10 | 104000 | 9900 | 158400 | 11.00 |
| | 149.0 | .690 | 15000 | 88000 | 21.25 | 108700 | 10350 | 166600 | 11.10 |
| 22 | 101.0 | .450 | 12910 | 52300 | 27.16 | 63900 | 5810 | 118200 | 14.84 |
| | 108.0 | .480 | 13330 | 57600 | 26.56 | 70400 | 6400 | 126700 | 14.30 |
| | 116.0 | .510 | 13700 | 62900 | 26.06 | 76900 | 6990 | 135400 | 13.87 |
| | 124.0 | .545 | 14090 | 69100 | 25.46 | 84500 | 7680 | 145500 | 13.45 |
| | 132.0 | .575 | 14370 | 75200 | 24.98 | 91700 | 8260 | 154400 | 13.09 |
| 24 | 107.0 | .485 | 12850 | 58800 | 27.23 | 71300 | 6230 | 138400 | 16.27 |
| | 113.0 | .500 | 13040 | 61700 | 27.39 | 74800 | 6520 | 143300 | 16.01 |
| | 120.0 | .530 | 13420 | 67500 | 26.72 | 81800 | 7110 | 152600 | 15.46 |
| | 128.0 | .570 | 13860 | 75300 | 25.55 | 91100 | 7900 | 165000 | 14.86 |
| | 132.0 | .570 | 13930 | 75200 | 26.33 | 91100 | 7940 | 163300 | 14.60 |
| | 140.0 | .600 | 14210 | 81000 | 25.93 | 98100 | 8530 | 172800 | 14.26 |
| | 148.0 | .640 | 14560 | 88800 | 25.09 | 107500 | 9320 | 185200 | 13.84 |
| 26 | 138.0 | .580 | 13530 | 78500 | 28.31 | 94200 | 7850 | 179600 | 16.38 |
| | 144.0 | .610 | 13820 | 84300 | 27.41 | 101100 | 8430 | 189400 | 16.00 |
| | 151.0 | .630 | 14020 | 88300 | 27.65 | 106000 | 8830 | 196600 | 15.76 |
| | 160.0 | .670 | 14390 | 96400 | 26.83 | 115700 | 9640 | 210000 | 15.30 |
| 28 | 145.0 | .585 | 13090 | 80000 | 31.20 | 95300 | 7660 | 194800 | 18.49 |
| | 156.0 | .635 | 13620 | 90600 | 29.54 | 107900 | 8650 | 212400 | 17.58 |
| | 165.0 | .675 | 13990 | 99100 | 28.65 | 118000 | 9440 | 226800 | 17.03 |
| | 175.0 | .710 | 14270 | 106700 | 28.10 | 126900 | 10130 | 239600 | 16.62 |
| | 186.0 | .730 | 14390 | 111100 | 29.00 | 132100 | 10510 | 248000 | 16.53 |
| 30 | 173.0 | .660 | 13420 | 97200 | 32.62 | 114900 | 8860 | 236600 | 19.23 |
| | 180.0 | .680 | 13590 | 101600 | 32.85 | 120100 | 9240 | 244800 | 18.99 |
| | 190.0 | .710 | 13850 | 108400 | 32.41 | 128100 | 9830 | 256600 | 18.57 |
| | 200.0 | .745 | 14120 | 116400 | 31.84 | 137400 | 10520 | 270400 | 18.14 |
| | 220.0 | .815 | 14590 | 132300 | 30.86 | 156100 | 11890 | 298300 | 17.46 |
| | 240.0 | .880 | 14960 | 147200 | 30.27 | 173600 | 13160 | 324700 | 16.98 |
| 33 | 200.0 | .700 | 13160 | 108000 | 37.37 | 126400 | 9210 | 276200 | 21.77 |
| | 210.0 | .735 | 13470 | 116300 | 36.49 | 136100 | 9900 | 291100 | 21.15 |
| | 220.0 | .765 | 13710 | 123600 | 35.99 | 144600 | 10490 | 304000 | 20.70 |
| | 230.0 | .795 | 13940 | 130900 | 35.66 | 153000 | 11080 | 317200 | 20.32 |
| | 245.0 | .835 | 14260 | 140700 | 35.45 | 164400 | 11860 | 335100 | 19.89 |
| | 260.0 | .875 | 14440 | 150500 | 35.25 | 175800 | 12640 | 353100 | 19.53 |
| 36 | 230.0 | .765 | 13170 | 125600 | 39.82 | 145800 | 10080 | 329400 | 23.71 |
| | 240.0 | .790 | 13370 | 132000 | 39.64 | 153100 | 10560 | 341300 | 23.32 |
| | 250.0 | .820 | 13600 | 139700 | 39.14 | 162000 | 11150 | 355400 | 22.84 |
| | 260.0 | .845 | 13780 | 146000 | 39.02 | 169500 | 11640 | 367500 | 22.51 |
| | 280.0 | .890 | 14060 | 158000 | 39.15 | 183000 | 12510 | 389800 | 22.03 |
| | 300.0 | .945 | 14380 | 172300 | 38.43 | 199500 | 13590 | 416400 | 21.46 |

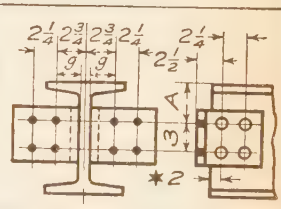
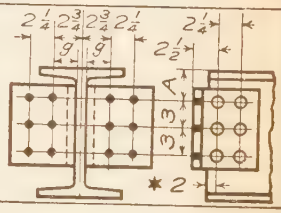
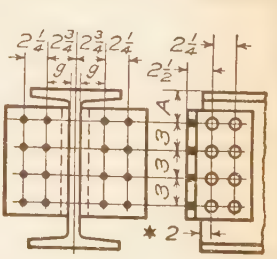
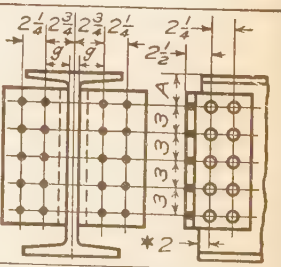
The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

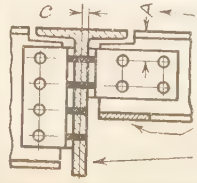
When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

# CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS

DIMENSIONS, WEIGHTS AND WORKING LOADS

3/4" POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value Outstanding Single Shear Web | Connection Value Outstanding Single Shear Power Driven Rivets | Connection Value Outstanding Single Shear Unfinished Bolts | Framing Distance C | Connection Angles A.I.S.C. Mark | Connection Angles Gage g | Connection Angles Size and Length | Weight inc. Web Rivets | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| 8" | 31.0 | 25650 | 47720 | 35340 | 3/16 | IC.16.10 | 2 5/8 | 6" × 6" × 3/8" 0' — 5 1/2" Long | 16 lbs. |  |
| | 33.0 | 26100 | 47720 | 35340 | 3/16 | IC.16.10 | 2 5/8 | | | |
| | 37.0 | 27920 | 47720 | 35340 | 3/16 | IC.16.10 | 2 5/8 | | | |
| 9" | 36.0 | 26100 | 47720 | 35340 | 3/16 | IC.16.10 | 2 5/8 | | | |
| | 38 5 | 27900 | 47720 | 35340 | 1/4 | IC.16.10 | 2 5/8 | | | |
| | 43.5 | 31500 | 47720 | 35340 | 3/16 | IC.16.10 | 2 5/8 | | | |
| 10" | 41.5 | 27900 | 47720 | 35340 | 1/4 | IC.16 10 | 2 5/8 | | | |
| | 44.5 | 28800 | 47720 | 35340 | 1/4 | IC.16. 9 | 2 9/16 | | | |
| | 50.0 | 32400 | 47720 | 35340 | 1/4 | IC.16. 9 | 2 9/16 | | | |
| 12" | 51.5 | 48600 | 71580 | 53020 | 1/4 | IC 24. 9 | 2 9/16 | 6" × 6" × 3/8" 0' — 8 1/2" Long | 24 lbs. |  |
| | 55.5 | 51300 | 71580 | 53020 | 1/4 | IC .24. 9 | 2 9/16 | | | |
| | 61.0 | 55350 | 71580 | 53020 | 1/4 | IC.24. 9 | 2 9/16 | | | |
| | 66.0 | 60750 | 71580 | 53020 | 5/16 | IC.24. 8 | 2 1/2 | | | |
| | 70.5 | 63450 | 71580 | 53020 | 5/16 | IC.24. 8 | 2 1/2 | | | |
| | 76.5 | 68850 | 71580 | 53020 | 5/16 | IC 24 8 | 2 1/2 | | | |
| 15" | 64.5 | 70200 | 95440 | 70690 | 1/4 | IC 33. 9 | 2 9/16 | 6" × 6" × 3/8" 0' — 11 1/2" Long | 33 lbs. |  |
| | 69.0 | 75600 | 95440 | 70690 | 1/4 | IC.33. 9 | 2 9/16 | | | |
| | 74.0 | 79200 | 95440 | 70690 | 5/16 | IC 33. 8 | 2 1/2 | | | |
| | 80.5 | 86400 | 95440 | 70690 | 5/16 | IC.33. 8 | 2 1/2 | | | |
| | 94.0 | 95440 | 95440 | 70690 | 5/16 | IC.33. 8 | 2 1/2 | | | |
| | 99.0 | 95440 | 95440 | 70690 | 3/8 | IC 33. 7 | 2 7/16 | | | |
| | 105 0 | 95440 | 95440 | 70690 | 3/8 | IC.33. 7 | 2 7/16 | | | |
| | 111.0 | 95440 | 95440 | 70690 | 3/8 | IC.33. 7 | 2 7/16 | | | |
| | 127.0 | 95440 | 95440 | 70690 | 7/16 | * | | | | |
| | 135 0 | 95440 | 95440 | 70690 | 7/16 | * | | | | |
| | 141.0 | 95440 | 95440 | 70690 | 7/16 | * | | | | |
| | 147.0 | 95440 | 95440 | 70690 | 1/2 | * | | | | |
| 16" | 74.5 | 70200 | 95440 | 70690 | 1/4 | IC.33. 9 | 2 9/16 | | | |
| | 81.0 | 75600 | 95440 | 70690 | 1/4 | IC.33. 9 | 2 9/16 | | | |
| | 87 0 | 81000 | 95440 | 70690 | 5/16 | IC.33. 8 | 2 1/2 | | | |
| | 94 0 | 87300 | 95440 | 70690 | 5/16 | IC.33. 8 | 2 1/2 | | | |
| 18" | 80 0 | 94500 | 119300 | 88360 | 1/4 | IC 41. 9 | 2 9/16 | 6" × 6" × 3/8" 1' — 2 1/2" Long | 41 lbs. |  |
| | 86.0 | 99000 | 119300 | 88360 | 5/16 | IC 41. 8 | 2 1/2 | | | |
| | 92 0 | 103500 | 119300 | 88360 | 5/16 | IC 41. 8 | 2 1/2 | | | |
| | 99 0 | 109100 | 119300 | 88360 | 5/16 | IC 41 8 | 2 1/2 | | | |
| 20" | 99 0 | 114800 | 119300 | 88360 | 5/16 | IC 41. 8 | 2 1/2 | | | |
| | 107 0 | 113900 | 119300 | 88360 | 5/16 | IC 41. 8 | 2 1/2 | | | |
| | 113.0 | 119300 | 119300 | 88360 | 3/8 | IC 41 8 | 2 1/2 | | | |
| | 120.0 | 119300 | 119300 | 88360 | 3/8 | IC 41 7 | 2 7/16 | | | |
| | 127 0 | 119300 | 119300 | 88360 | 3/8 | IC 41 7 | 2 7/16 | | | |
| | 135 0 | 119300 | 119300 | 88360 | 3/8 | IC 41. 7 | 2 7/16 | | | |
| | 142 0 | 119300 | 119300 | 88360 | 3/8 | IC 41 7 | 2 7/16 | | | |
| | 149 0 | 119300 | 119300 | 88360 | 7/16 | IC 41 7 | 2 7/16 | | | |




*Special Connections must be used for 15", *127*, *135*, *141*, and *147 lb.*, Girder Beams. The values given are for 8 web and 16 field rivets.

Following Beams can be framed opposite with tops flush when:—
A = 2 3/4" all 8", 9", 10", 12", 15" to *80.5 lb.*, and 16".
A = 3" all 9", 10", 12", 15"*, 16", 18", 20", 22", and 24", to *129 lb.*
A = 3 1/4" all 9", 10", 12", 15", to *80.5 lb.*, 16", 18", *93* and *100 lb.*, 20", 22", 24" and 26"
A = 3 1/2" all 10", 12", 20", 22", 24", 26", 28" and 30".

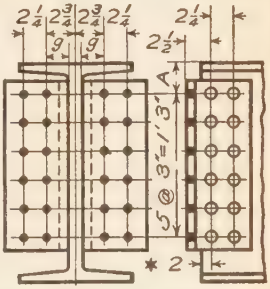
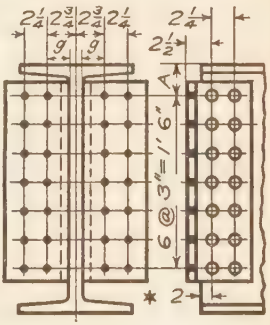
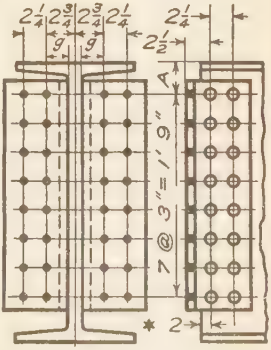
Flange must be cut away as shown for field riveting on all beams framing opposite a larger beam, if flange interferes with outstanding rivets.

Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

LOADS BY A. I. S. C. SPECIFICATION

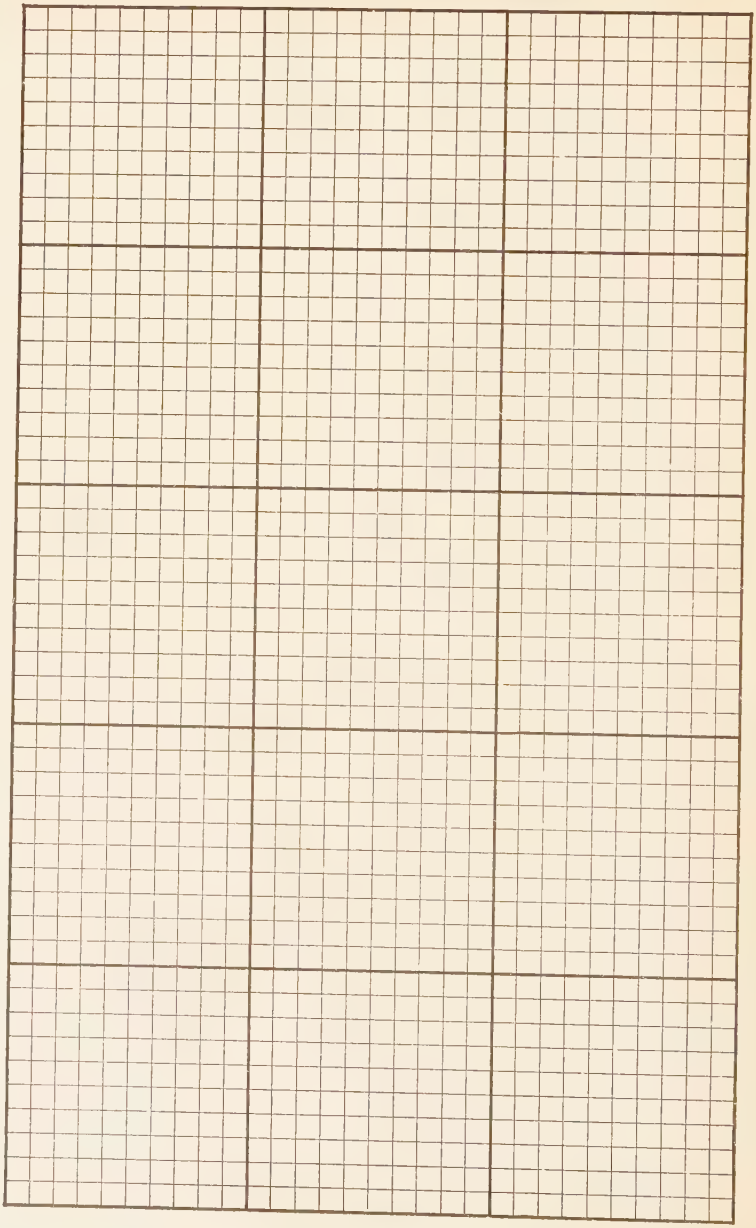
# CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value: Web | Connection Value: Outstanding Single Shear: Power Driven Rivets | Connection Value: Outstanding Single Shear: Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Weight inc. Web Rivets | Connection Details |
|---|---|---|---|---|---|---|---|---|---|---|
| 22" | 101.0 | 121600 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | 6" × 6" × 3/8" 1' — 5 1/2" Long | 49 lbs. |  |
| | 108.0 | 129600 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 116.0 | 137800 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 124.0 | 143160 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 132.0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| 24" | 107.0 | 130980 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 113.0 | 135000 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 120.0 | 143160 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 128.0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| | 132.0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| | 140.0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| | 148.0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| 26" | 138.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | 6" × 6" × 3/8" 1' — 8 1/2" Long | 58 lbs. |  |
| | 144.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| | 151.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| | 160.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| 28" | 145.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| | 156.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| | 165.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| | 175.0 | 167020 | 167020 | 123700 | 7/16 | IC.58. 6 | 2 3/8 | | | |
| | 186.0 | 167020 | 167020 | 123700 | 7/16 | IC.58. 6 | 2 3/8 | | | |
| 30" | 173.0 | 190880 | 190880 | 141380 | 3/8 | IC.66. 7 | 2 7/16 | 6" × 6" × 3/8" 1' — 11 1/2" Long | 66 lbs. |  |
| | 180.0 | 190880 | 190880 | 141380 | 3/8 | IC.66. 7 | 2 7/16 | | | |
| | 190 0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 200.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 220.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 240.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| 33" | 200.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 210 0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 220 0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 230.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 245.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 260.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| 36" | 230.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 240 0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 250 0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 260.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 280.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 300.0 | 190880 | 190880 | 141380 | 9/16 | IC.66. 4 | 2 1/4 | | | |

*Layer-out starts with this dimension at left end of beam. With beams ordered one inch short, as usual in standard shop practice, this leaves sufficient end distance or clearance at right end, in case of full allowable 1/2" underrun or 1/2" overrun in beam lengths.

## NOTES and DIAGRAMS



# Part IV

# Section 7

## CARNEGIE BEAM SECTIONS

### Dimensions—Technical Functions

### Allowable Total Loads by A. I. S. C. Specification

### Allowable End Reactions—Standard Connection Angles

| Usual Stock Sizes | | | | | |
|---|---|---|---|---|---|
| Depth | Weight | Depth | Weight | Depth | Weight |
| 8″ | 24.0 # | 16″ | 35.0 # | 30″ | 115.0 # |
| 9″ | 29.0 # | 18″ | 47.0 # | 33″ | 125.0 # |
| 10″ | 21.0 # | 21″ | 55.0 # | 36″ | 147.0 # |
| 12″ | 25.0 # | 24″ | 70.0 # | | |
| 14″ | 30.0 # | 27″ | 85.0 # | | |

**Manufacturers Section Index**

| Sec. Index | Depth | Weight | | | | | Sec. Index | Depth | Weight | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CB 82 | 8″ | 24.0 | 27.0 | 30.0 | | | CB 181 | 18″ | 47.0 | 51.0 | 52.0 | 58 0 | | |
| CB 83 | 8″ | 31.0 | 36 0 | 42 0 | | | CB 182 | 18″ | 67.0 | 72 0 | 78 0 | | | |
| CB 92 | 9″ | 29.0 | 32.0 | 35.0 | | | CB 183 | 18″ | 86.0 | 93.0 | 100.0 | | | |
| CB 93 | 9″ | 38 0 | 43.0 | 48 0 | | | CB 211 | 21″ | 55.0 | 58 0 | 64 0 | 70 0 | 76 0 | |
| CB 101 | 10″ | 21.0 | 23.0 | 26.0 | 30.0 | | CB 212 | 21″ | 80.0 | 86.0 | 92.0 | 98.0 | | |
| CB 102 | 10″ | 31 0 | 36.0 | 42 0 | | | CB 213 | 21″ | 104.0 | 112.0 | 120 0 | 128.0 | 136 0 | |
| CB 103A | 10″ | 49.0 | 54.0 | 59.0 | 64.0 | | CB 241 | 24″ | 70.0 | | | | | |
| CB 121 | 12″ | 25.0 | | | | | CB 242 | 24″ | 76.0 | 85.0 | 94.0 | | | |
| CB 122 | 12″ | 28.0 | 32 0 | 34 0 | 36 0 | | CB 243 | 24″ | 100 0 | 110.0 | 120 0 | | | |
| CB 123 | 12″ | 40 0 | 45.0 | 50 0 | | | CB 244 | 24″ | 130.0 | 140.0 | 150.0 | 160.0 | | |
| CB 123B | 12″ | 55.0 | 60 0 | 66 0 | | | CB 271 | 27″ | 85 0 | 91.0 | 101 0 | 112 0 | 124.0 | 137 0 |
| CB 124B | 12″ | 65.0 | 70.0 | 76.0 | | | CB 272 | 27″ | 145.0 | 160.0 | 175.0 | 190.0 | | |
| CB 141 | 14″ | 30 0 | | | | | CB 301 | 30″ | 115.0 | 126.0 | 138 0 | 151 0 | 165.0 | |
| CB 142 | 14″ | 33.0 | 36 0 | 38.0 | 39 0 | 42.0 | CB 302 | 30″ | 180 0 | 200 0 | 220 0 | 240 0 | | |
| CB 143 | 14″ | 48.0 | 53.0 | 58.0 | | | CB 331 | 33″ | 125.0 | 138.0 | 152.0 | 167.0 | | |
| CB 144 | 14″ | 61.0 | 68.0 | 75.0 | | | CB 332 | 33″ | 200 0 | 220.0 | 240.0 | 260.0 | | |
| CB 145 | 14″ | 85.0 | 95 0 | 105.0 | | | CB 361 | 36″ | 147.0 | 160.0 | 175 0 | 192.0 | | |
| CB 161 | 16″ | 35.0 | 38.0 | | | | CB 362 | 36″ | 230.0 | 250.0 | 275 0 | 300.0 | | |
| CB 162 | 16″ | 40.0 | 43.0 | 45.0 | 50.0 | | | | | | | | | |
| CB 163 | 16″ | 58.0 | 63 0 | 68.0 | | | | | | | | | | |
| CB 164 | 16″ | 76 0 | 83.0 | 90 0 | | | | | | | | | | |
| CB 165 | 16″ | 100.0 | 107 0 | 115.0 | | | | | | | | | | |

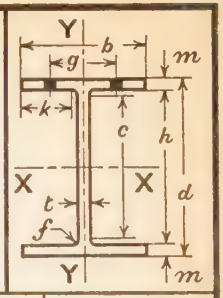
# 8" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



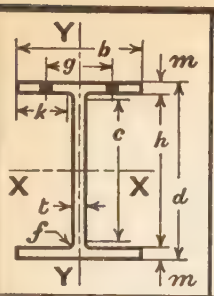

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d". | | 8.000 | 8.098 | 8.196 | 8.060 | 8.198 | 8.360 |
| Wt. per foot. | | 24.0 | 27.0 | 30.0 | 31.0 | 36.0 | 42.0 |
| Area | | 7.06 | 7.93 | 8.81 | 9.10 | 10.58 | 12.34 |
| b" | | 6.500 | 6.529 | 6.559 | 8.000 | 8.046 | 8.100 |
| t | | .239 | .268 | .298 | .290 | .336 | .390 |
| h | | 7 3/16 | 7 3/16 | 7 3/16 | 7 3/16 | 7 3/16 | 7 3/16 |
| m | | .400 | .449 | .498 | .430 | .499 | .580 |
| k | | 2 11/16 | 2 11/16 | 2 11/16 | 3/8 | 3/8 | 3/8 |
| f | | .45 | .45 | .45 | .45 | .45 | .45 |
| c | | 6¼ | 6¼ | 6¼ | 6¼ | 6¼ | 6¼ |
| g | | 3" | 3" | 3" | 5½ | 5½ | 5½ |
| AXES X-X | I | 84.3 | 95.9 | 107.8 | 110.9 | 131.3 | 156.2 |
| | S | 21.08 | 23.68 | 26.31 | 27.52 | 32.03 | 37.37 |
| | r | 3.46 | 3.48 | 3.50 | 3.49 | 3.52 | 3.56 |
| AXES Y-Y | I | 18.3 | 20.8 | 23.4 | 36.7 | 43.4 | 51.4 |
| | S | 5.6 | 6.4 | 7.1 | 9.2 | 10.8 | 12.7 |
| | r | 1.61 | 1.62 | 1.63 | 2.01 | 2.02 | 2.04 |
| Coef. Str. | | 252900 | 284200 | 315700 | 330200 | 384400 | 448400 |
| Max. Mom."# | | 379400 | 426300 | 473500 | 495300 | 576600 | 672600 |
| V | | 22900 | 26000 | 29300 | 28100 | 33100 | 39100 |
| P. feet | | 5.52 | 5.46 | 5.38 | 5.88 | 5.81 | 5.74 |
| R | | 19720 | 22210 | 24800 | 23990 | 27970 | 32700 |
| W | | 21510 | 23860 | 23860 | 26100 | 30240 | 35100 |
| Q feet | | 5.88 | 5.95 | 6.62 | 6.32 | 6.35 | 6.38 |
| w lbs | | 13 | 13 | 13 | 16 | 16 | 16 |
| Rivet dia | | ¾ | ¾ | ¾ | ⅞ | ⅞ | ⅞ |

Live Load deflection must not exceed 1/360 of the span.

Live Load Def. = $\frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 45.9 | 45.9 | 52.1 | 52.1 | 58.6 | 58.6 | 56.1 | 56.1 | 66.1 | 66.1 | 78.2 | 78.2 | |
| 4 | 45.9 | 45.9 | 52.1 | 52.1 | 58.6 | 58.6 | 56.1 | 56.1 | 66.1 | 66.1 | 78.2 | 78.2 | |
| 5 | 45.9 | 45.9 | 52.1 | 52.1 | 58.6 | 58.6 | 56.1 | 56.1 | 66.1 | 66.1 | 78.2 | 78.2 | |
| 6 | 42.1 | 42.1 | 47.3 | 47.3 | 52.6 | 52.6 | 55.0 | 55.0 | 64.1 | 64.1 | 74.8 | 71.8 | .084 |
| 7 | 36.1 | 36.1 | 40.6 | 40.6 | 45.1 | 45.1 | 47.2 | 47.2 | 54.9 | 54.9 | 64.1 | 64.1 | .114 |
| 8 | 31.6 | 31.6 | 35.5 | 35.5 | 39.5 | 39.5 | 41.3 | 41.3 | 48.0 | 48.0 | 56.1 | 56.1 | .149 |
| 9 | 28.1 | 27.5 | 31.6 | 30.9 | 35.1 | 34.3 | 36.7 | 36.7 | 42.7 | 42.7 | 49.8 | 49.8 | .189 |
| 10 | 25.3 | 24.0 | 28.4 | 27.0 | 31.6 | 30.1 | 33.0 | 33.0 | 38.4 | 38.4 | 44.9 | 44.9 | .233 |
| 11 | 23.0 | 21.2 | 25.8 | 23.8 | 28.7 | 26.5 | 30.0 | 29.4 | 34.9 | 34.2 | 40.8 | 40.0 | .281 |
| 12 | 21.1 | 18.8 | 23.7 | 21.2 | 26.3 | 23.5 | 27.5 | 26.3 | 32.0 | 30.6 | 37.4 | 36.6 | .335 |
| 13 | 19.4 | 16.8 | 21.9 | 18.9 | 24.3 | 21.1 | 25.4 | 23.7 | 29.6 | 27.6 | 34.5 | 32.3 | .394 |
| 14 | 18.1 | 15.1 | 20.3 | 16.9 | 22.6 | 18.9 | 23.6 | 21.5 | 27.5 | 25.0 | 32.0 | 29.3 | .456 |
| 15 | 16.9 | ... | 18.9 | .... | 21.1 | .... | 22.0 | .... | 25.6 | .... | 29.9 | 26.6 | .524 |
| 16 | 15.8 | ... | 17.8 | .... | 19.7 | .... | 20.6 | ... | 24.0 | ... | 28.0 | ... | .596 |
| 17 | 14.9 | ... | 16.7 | ... | 18.6 | .... | 19.4 | .... | 22.6 | .... | 26.4 | .... | .674 |
| 18 | 14.1 | .... | 15.8 | .... | 17.5 | ... | 18.3 | ... | 21.4 | .... | 24.9 | .... | .754 |
| 19 | 13.3 | .... | 15.0 | .... | 16.6 | .... | 17.4 | .... | 20.2 | .... | 23.6 | .... | .840 |
| 20 | 12.6 | .... | 14.2 | .... | 15.8 | .... | 16.5 | .... | 19.2 | .... | 22.4 | .... | .931 |
| 21 | 12.0 | ... | 13.5 | .. | 15.0 | .... | 15.7 | ... | 18.3 | .... | 21.5 | .... | 1.03 |
| 22 | 11.5 | . | 12.9 | . | 14.4 | .... | 15.0 | ... | 17.5 | .... | 20.4 | .... | 1.13 |
| 23 | 11.0 | . | 12.4 | . | 13.7 | .. | 14.4 | ... | 16.7 | .... | 19.5 | .... | 1.23 |
| 24 | 10.5 | ... | 11.8 | .. | 13.2 | .. | 13.8 | .... | 16.0 | .... | 18.7 | .... | 1.34 |
| 25 | 10.1 | ... | 11.4 | .. | 12.6 | . | 13.2 | ... | 15.4 | .. | 17.9 | .... | 1.46 |




# CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 9" C

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d". | | 9.000 | | 9.096 | | 9.192 | | 9.000 | | 9.122 | | 9.242 | |
| Wt. per foot. | | 29.0 | | 32.0 | | 35.0 | | 38.0 | | 43.0 | | 48.0 | |
| Area | | 8.53 | | 9.40 | | 10.29 | | 11.17 | | 12.65 | | 14.11 | |
| b" | | 6.500 | | 6.528 | | 6.556 | | 9.000 | | 9.041 | | 9.082 | |
| t | | .279 | | .307 | | .335 | | .316 | | .357 | | .398 | |
| h | | 8" | | 8" | | 8" | | 8" | | 8" | | 8" | |
| m | | .470 | | .518 | | .566 | | .470 | | .531 | | .591 | |
| k | | 2⅝ | | 2⅝ | | 2⅝ | | 3 13/16 | | 3 13/16 | | 3 13/16 | |
| f | | .50 | | .50 | | .50 | | .50 | | .50 | | .50 | |
| c | | 7" | | 7" | | 7" | | 7" | | 7" | | 7" | |
| g | | 3" | | 3" | | 3" | | 5½ | | 5½ | | 5½ | |
| AXES X-X | I | 126.0 | | 140.5 | | 155.4 | | 170.4 | | 195.5 | | 221.1 | |
| | S | 28.00 | | 30.89 | | 33.81 | | 37.87 | | 42.86 | | 47.85 | |
| | r | 3.84 | | 3.87 | | 3.89 | | 3.91 | | 3.93 | | 3.96 | |
| AXES Y-Y | I | 21.5 | | 24.0 | | 26.6 | | 57.1 | | 65.4 | | 73.8 | |
| | S | 6.6 | | 7.4 | | 8.1 | | 12.7 | | 14.5 | | 16.3 | |
| | r | 1.59 | | 1.60 | | 1.61 | | 2.26 | | 2.28 | | 2.29 | |
| Coef. Str. | | 336000 | | 370700 | | 405700 | | 454400 | | 514400 | | 574200 | |
| Max. Mom. "# | | 504000 | | 556100 | | 608600 | | 681600 | | 771500 | | 861200 | |
| V | | 30100 | | 33500 | | 37000 | | 34100 | | 39100 | | 44100 | |
| P. feet | | 5.58 | | 5 53 | | 5.49 | | 6 66 | | 6.59 | | 6.50 | |
| R | | 24060 | | 26590 | | 29130 | | 27250 | | 30950 | | 34690 | |
| W | | 23860 | | 23860 | | 23860 | | 28440 | | 32130 | | 35820 | |
| Q. feet | | 7.04 | | 7.77 | | 8.50 | | 6.98 | | 8.00 | | 8.01 | |
| w lbs | | 13 | | 13 | | 13 | | 16 | | 16 | | 16 | |
| Rivet dia | | ¾ | | ¾ | | ¾ | | ⅞ | | ⅞ | | ⅞ | |

Live Load Deflection must not exceed 1/360 of the Span.

Live Load Def. = (Total Def. × Live Load) / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 60.3 | 60.3 | 67.0 | 67.0 | 73.9 | 73 9 | 68 3 | 68.3 | 78.2 | 78.2 | 88.3 | 88.3 | |
| 4 | 60.3 | 60.3 | 67.0 | 67.0 | 73.9 | 73 9 | 68.3 | 68.3 | 78.2 | 78.2 | 88.3 | 88.3 | |
| 5 | 60.3 | 60.3 | 67.0 | 67.0 | 73.9 | 73.9 | 68.3 | 68.3 | 78.2 | 78.2 | 88.3 | 88.3 | |
| 6 | 56.0 | 56.0 | 61.8 | 61.8 | 67.6 | 67.6 | 68.3 | 68.3 | 78.2 | 78.2 | 88.3 | 88 3 | |
| 7 | 48.0 | 48.0 | 53.0 | 53.0 | 58.0 | 58.0 | 64.9 | 64.9 | 73.5 | 73.5 | 82.0 | 82.0 | .101 |
| 8 | 42.0 | 42.0 | 46.4 | 46 4 | 50.7 | 50.7 | 56.8 | 56.8 | 64.3 | 64.3 | 71.8 | 71.8 | .132 |
| 9 | 37.3 | 36.5 | 41.2 | 40.3 | 45.1 | 44.1 | 50.5 | 50.5 | 57.2 | 57.2 | 63.8 | 63.8 | .168 |
| 10 | 33.6 | 31.9 | 37.1 | 35.2 | 40.6 | 38.7 | 45.4 | 45.4 | 51.4 | 51.4 | 57.4 | 57.4 | .207 |
| 11 | 30.5 | 28.2 | 33.7 | 31.1 | 36.9 | 34.0 | 41.3 | 41.3 | 46.8 | 46.8 | 52.2 | 52.2 | .250 |
| 12 | 28.0 | 24.9 | 30.9 | 27.6 | 33.8 | 30.3 | 37.9 | 37.3 | 42.9 | 42 2 | 47.8 | 47.3 | .298 |
| 13 | 25.8 | 22.3 | 28 5 | 24.6 | 31.2 | 27.1 | 35.0 | 33 8 | 39.6 | 38.3 | 44.2 | 42 7 | .350 |
| 14 | 24.0 | 20.0 | 26.5 | 22.1 | 29.0 | 24.2 | 32.5 | 30.7 | 36.7 | 34.9 | 41.0 | 38 9 | .406 |
| 15 | 22.4 | 18.0 | 24.7 | 19.9 | 27.1 | 21.8 | 30.3 | 28.1 | 34.3 | 31.8 | 38.3 | 35.6 | .466 |
| 16 | 21.0 | 16.3 | 23.2 | 17.9 | 25.4 | 19.7 | 28.4 | 25.7 | 32.2 | 29.1 | 35.9 | 32.5 | .530 |
| 17 | 19.8 | .... | 21.8 | .... | 23.9 | .... | 26 7 | .... | 30.3 | .... | 33.8 | .... | .599 |
| 18 | 18.7 | .... | 20.6 | .... | 22.5 | .... | 25 2 | .... | 28.6 | .... | 31.9 | .... | .670 |
| 19 | 17.7 | .... | 19.5 | .... | 21.4 | .... | 23.9 | .... | 27.1 | .... | 30.2 | .... | .747 |
| 20 | 16.8 | .... | 18.5 | .... | 20.3 | .... | 22.7 | .... | 25.7 | .... | 28.7 | .... | .828 |
| 21 | 16.0 | .... | 17.7 | .... | 19.3 | .... | 21.6 | .... | 24.5 | .... | 27.3 | .... | .912 |
| 22 | 15.3 | .... | 16.9 | .... | 18.4 | .... | 20.7 | .... | 23.4 | .... | 26.1 | .... | 1.00 |
| 23 | 14.6 | .... | 16.1 | .... | 17.6 | .... | 19.8 | .... | 22.4 | .... | 25.0 | .... | 1.10 |
| 24 | 14.0 | .... | 15.4 | .... | 16.9 | .... | 18.9 | .... | 21.4 | .... | 23.9 | .... | 1.19 |
| 25 | 13.4 | .... | 14.8 | .... | 16.2 | .... | 18.2 | .... | 20.6 | .... | 23.0 | .... | 1.29 |

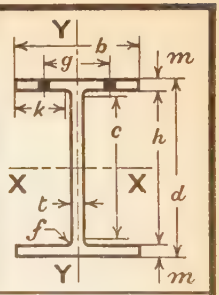
# 10" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



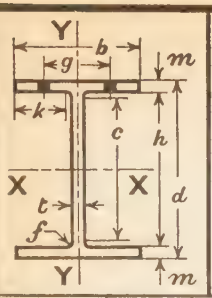

| | | | | | |
|---|---|---|---|---|---|
| Depth = d" | | 9 902 | 10.000 | 10 098 | 10 228 |
| Wt. per foot | | 21 0 | 23 0 | 26 0 | 30 0 |
| Area | | 6 17 | 6.76 | 7.64 | 8 82 |
| b" | | 6 000 | 6 000 | 6 029 | 6 068 |
| t. | | 230 | 230 | 259 | 298 |
| h | | 93/16 | 93/16 | 93/16 | 93/16 |
| m | | 332 | 381 | 430 | 495 |
| k | | 29/16 | 29/16 | 29/16 | 29/16 |
| f | | 30 | 30 | 30 | 30 |
| c | | 85/8 | 85/8 | 85/8 | 85/8 |
| g | | 3" | 3" | 3" | 3" |
| AXES X-X | I | 107 6 | 122 2 | 139 5 | 163 2 |
| | S | 21 73 | 24 44 | 27 63 | 31 91 |
| | r | 4 18 | 4 25 | 4 27 | 4 30 |
| AXES Y-Y | I | 12 0 | 13 7 | 15 7 | 18 5 |
| | S | 4 0 | 4 6 | 5 2 | 6 1 |
| | r | 1 39 | 1 43 | 1 43 | 1 45 |
| Coef Sur | | 260800 | 293300 | 331500 | 382900 |
| Max.Mom."/# | | 391200 | 439900 | 497300 | 574400 |
| V | | 27300 | 27600 | 31400 | 36600 |
| P. feet | | 4 76 | 5 30 | 5 28 | 5 23 |
| R | | 18900 | 18890 | 22410 | 27070 |
| W | | 20700 | 20700 | 23310 | 23860 |
| Q feet | | 6 29 | 7 08 | 7 11 | 8 02 |
| w lbs | | 13 | 13 | 13 | 13 |
| Rivet dia | | ¾ | ¾ | ¾ | ¾ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 55 | 55 | 55 | 55 | 63 | 63 | 73 | 73 | |
| 4 | 55 | 55 | 55 | 55 | 63 | 63 | 73 | 73 | |
| 5 | 52 | 52 | 55 | 55 | 63 | 63 | 73 | 73 | |
| 6 | 44 | 44 | 49 | 49 | 55 | 55 | 64 | 64 | .067 |
| 7 | 37 | 37 | 42 | 42 | 47 | 47 | 55 | 55 | .091 |
| 8 | 33 | 32 | 37 | 36 | 41 | 41 | 48 | 47 | .119 |
| 9 | 29 | 28 | 33 | 31 | 37 | 35 | 43 | 41 | .151 |
| 10 | 26 | 24 | 29 | 27 | 33 | 31 | 38 | 36 | .186 |
| 11 | 24 | 21 | 27 | 24 | 30 | 27 | 35 | 31 | .225 |
| 12 | 22 | 19 | 24 | 21 | 28 | 24 | 32 | 29 | .268 |
| 13 | 20 | 17 | 23 | 19 | 26 | 21 | 30 | 25 | .315 |
| 14 | 19 | 15 | 21 | 17 | 24 | 19 | 27 | 22 | .365 |
| 15 | 17 | 13 | 20 | 15 | 22 | 17 | 26 | 20 | .419 |
| 16 | 16 | 12 | 18 | 14 | 21 | 15 | 24 | 18 | .477 |
| 17 | 15 | 11 | 17 | 12 | 20 | 14 | 23 | 16 | .539 |
| 18 | 15 | | 16 | | 18 | 13 | 21 | 15 | .603 |
| 19 | 14 | | 15 | | 18 | | 20 | | .672 |
| 20 | 13 | . | 15 | | 17 | . | 19 | . | .745 |
| 21 | 12 | . | 14 | . | 16 | | 18 | . . | .821 |
| 22 | 12 | . . | 13 | . | 15 | | 17 | . | .901 |
| 23 | 11 | | 13 | . | 14 | . | 17 | . | .986 |
| 24 | 11 | . . | 12 | | 14 | | 16 | . . . | 1 07 |
| 25 | 10 | . | 12 | | 13 | | 15 | . . | 1 16 |




# CARNEGIE BEAMS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 10″ C

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 10.000 | 10.000 | 10.000 | 10.000 | 10.000 | 10.000 | 10.000 | |
| Wt. per foot. | | 31.0 | 36.0 | 42.0 | 49.0 | 54.0 | 59.0 | 64.0 | |
| Area | | 9.11 | 10.58 | 12.35 | 14.40 | 15.87 | 17.34 | 18.81 | |
| b″ | | 8.000 | 8.147 | 8.324 | 10.000 | 10.147 | 10.294 | 10.441 | |
| t | | .320 | .467 | .644 | .350 | .497 | .644 | .791 | |
| h | | 9 3/16 | 9 3/16 | 9 3/16 | 8 7/8 | 8 7/8 | 8 7/8 | 8 7/8 | |
| m | | .381 | .381 | .381 | .558 | .558 | .558 | .558 | |
| k | | 3 9/16 | 3 9/16 | 3 9/16 | 4 3/8 | 4 3/8 | 4 3/8 | 4 3/8 | |
| f | | .30 | .30 | .30 | .45 | .45 | .45 | .45 | |
| c | | 8 5/8 | 8 5/8 | 8 5/8 | 7 15/16 | 7 15/16 | 7 15/16 | 7 15/16 | |
| g | | 4″ | 4″ | 4″ | 5½ | 5½ | 5½ | 5½ | |
| AXES X-X | I | 163.4 | 175.6 | 190.4 | 272.0 | 284.3 | 296.5 | 308.8 | |
| | S | 32.68 | 35.12 | 38.08 | 54.40 | 56.86 | 59.30 | 61.76 | |
| | r | 4.23 | 4.07 | 3.93 | 4.35 | 4.23 | 4.13 | 4.05 | |
| AXES Y-Y | I | 32.5 | 34.4 | 36.8 | 93.0 | 97.3 | 101.7 | 106.3 | |
| | S | 8.1 | 8.5 | 8.9 | 18.6 | 19.2 | 19.8 | 20.4 | |
| | r | 1.89 | 1.80 | 1.73 | 2.54 | 2.48 | 2.42 | 2.38 | |
| Coef. Str. | | 392200 | 421400 | 457000 | 652800 | 682300 | 711600 | 741120 | |
| Max. Mom.″/₈ | | 588200 | 632200 | 685400 | 979200 | 1023500 | 1067400 | 1111700 | |
| V | | 38400 | 56000 | 77300 | 42000 | 59600 | 77300 | 94900 | |
| P. feet | | 5 11 | 3 76 | 2 96 | 7.77 | 5 72 | 4 60 | 3 90 | |
| R | | 28800 | 42030 | 57960 | 31500 | 44730 | 57960 | 71190 | |
| W | | 28800 | 42030 | 47720 | 31520 | 44730 | 47720 | 47720 | |
| Q feet | | 6 81 | 5.01 | 4.79 | 10.36 | 7 63 | 7.46 | 7.77 | |
| w lbs. | | 16 | 16 | 16 | 16 | 16 | 16 | 16 | |
| Rivet dia. | | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 77 | 77 | 112 | 112 | 152 | 152 | 84 | 84 | 119 | 119 | 155 | 155 | 190 | 190 | |
| 4 | 77 | 77 | 105 | 105 | 114 | 114 | 84 | 84 | 119 | 119 | 155 | 155 | 185 | 185 | |
| 5 | 77 | 77 | 84 | 84 | 91 | 91 | 84 | 84 | 119 | 119 | 142 | 142 | 148 | 148 | |
| 6 | 65 | 65 | 70 | 70 | 76 | 76 | 84 | 84 | 114 | 114 | 119 | 119 | 124 | 124 | |
| 7 | 56 | 56 | 60 | 60 | 65 | 65 | 84 | 84 | 97 | 97 | 102 | 102 | 106 | 106 | |
| 8 | 49 | 49 | 53 | 53 | 57 | 57 | 82 | 82 | 85 | 85 | 89 | 89 | 93 | 93 | .119 |
| 9 | 44 | 44 | 47 | 47 | 51 | 51 | 73 | 73 | 76 | 76 | 79 | 79 | 82 | 82 | .151 |
| 10 | 39 | 39 | 42 | 42 | 46 | 46 | 65 | 65 | 68 | 68 | 71 | 71 | 74 | 74 | .186 |
| 11 | 36 | 35 | 38 | 38 | 42 | 41 | 59 | 59 | 62 | 62 | 65 | 65 | 67 | 67 | .225 |
| 12 | 33 | 31 | 35 | 34 | 38 | 37 | 54 | 54 | 57 | 57 | 59 | 59 | 62 | 62 | .268 |
| 13 | 30 | 28 | 32 | 30 | 35 | 33 | 50 | 50 | 52 | 52 | 55 | 55 | 57 | 57 | .315 |
| 14 | 28 | 26 | 30 | 28 | 33 | 30 | 47 | 45 | 49 | 48 | 51 | 50 | 53 | 52 | .365 |
| 15 | 26 | 23 | 28 | 25 | 31 | 28 | 44 | 42 | 45 | 44 | 47 | 46 | 49 | 48 | .419 |
| 16 | 25 | 21 | 26 | 23 | 29 | 25 | 41 | 38 | 43 | 40 | 44 | 42 | 46 | 44 | .477 |
| 17 | 23 | 19 | 25 | 21 | 27 | 23 | 38 | 35 | 40 | 37 | 42 | 39 | 44 | 41 | .539 |
| 18 | 22 | ... | 23 | ... | 25 | ... | 36 | ... | 38 | ... | 40 | ... | 41 | ... | .603 |
| 19 | 21 | ... | 22 | ... | 24 | ... | 34 | ... | 36 | ... | 37 | ... | 39 | ... | .672 |
| 20 | 20 | ... | 21 | ... | 23 | ... | 33 | ... | 34 | ... | 36 | ... | 37 | ... | .745 |
| 21 | 19 | ... | 20 | ... | 22 | ... | 31 | ... | 32 | ... | 34 | ... | 35 | ... | .821 |
| 22 | 18 | ... | 19 | ... | 21 | ... | 30 | ... | 31 | ... | 32 | ... | 34 | ... | .901 |
| 23 | 17 | ... | 18 | ... | 20 | ... | 28 | ... | 30 | ... | 31 | ... | 32 | ... | .986 |
| 24 | 16 | ... | 18 | ... | 19 | ... | 27 | ... | 28 | ... | 30 | ... | 31 | ... | 1.07 |
| 25 | 16 | ... | 17 | ... | 18 | ... | 26 | ... | 27 | ... | 28 | ... | 30 | ... | 1.16 |

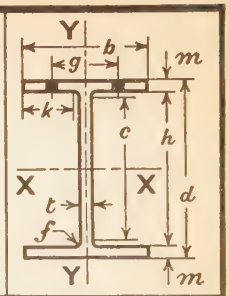
# 12" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d". | | 11.924 | 12 000 | 12 118 | *12 022 | 12 236 | 12 000 | 12 130 | 12.258 |
| Wt. per foot. | | 25 0 | 28 0 | 32 0 | 34 0 | 36 0 | 40 0 | 45 0 | 50 0 |
| Area | | 7.34 | 8 22 | 9 40 | 9 99 | 10 59 | 11 76 | 13 23 | 14 69 |
| | b" | 6 000 | 6.500 | 6 534 | 6 635 | 6 568 | 8 000 | 8 036 | 8 071 |
| | t | .240 | .240 | .274 | .375 | .308 | .290 | .326 | .361 |
| | h | 11⅛ | 11⅛ | 11⅛ | 11⅛ | 11⅛ | 10 15/16 | 10 15/16 | 10 15/16 |
| | m | .382 | 420 | 479 | 431 | 538 | .526 | 591 | .655 |
| | k | 2½ | 2¾ | 2¾ | 2¾ | 2¾ | 3⅜ | 3⅜ | 3⅜ |
| | f | .35 | .35 | .35 | .35 | .35 | .50 | .50 | .50 |
| | c | 10⅜ | 10⅜ | 10⅜ | 10⅜ | 10⅜ | 9⅞ | 9⅞ | 9⅞ |
| | g | 3" | 3½ | 3½ | 3½ | 3½ | 4" | 4" | 4" |
| AXES X-X | I | 183.0 | 213.4 | 246.3 | 238.1 | 280.1 | 313.7 | 356.9 | 400 5 |
| | S | 30.69 | 35.57 | 40.65 | 39.61 | 45.78 | 52.28 | 58.85 | 65 35 |
| | r | 4.99 | 5.10 | 5.12 | 4.88 | 5.14 | 5.17 | 5.19 | 5 22 |
| AXES Y-Y | I | 13.8 | 19.2 | 22.3 | 21.0 | 25.4 | 44.9 | 51.2 | 57 5 |
| | S | 4.6 | 5.9 | 6.8 | 6.3 | 7.7 | 11.2 | 12.7 | 14 2 |
| | r | 1.37 | 1.53 | 1.54 | 1.45 | 1.55 | 1.95 | 1.97 | 1.98 |
| Coef. Str. | | 368300 | 426800 | 487800 | 475300 | 549400 | 627400 | 706100 | 784100 |
| Max.Mom."# | | 552500 | 640200 | 731700 | 713000 | 824100 | 941100 | 1059200 | 1176200 |
| V | | 34300 | 34600 | 39800 | 45100 | 45200 | 41800 | 47500 | 53100 |
| P. feet | | 5.36 | 6 18 | 6 13 | 4 39 | 6 08 | 7.51 | 7.43 | 7 39 |
| R | | 19840 | 19820 | 24290 | 36590 | 28790 | 26400 | 31140 | 35550 |
| W | | 21600 | 21600 | 23860 | 23860 | 23860 | 23860 | 23860 | 23860 |
| Q feet | | 8.53 | 9 88 | 10 22 | 9 96 | 11 51 | 13 14 | 14 79 | 16.43 |
| w lbs. | | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| Rivet dia | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ |

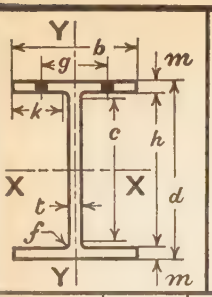
Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 69 | 69 | 69 | 69 | 80 | 80 | 108 | 108 | 90 | 90 | 84 | 84 | 95 | 95 | 106 | 106 | |
| 4 | 69 | 69 | 69 | 69 | 80 | 80 | 108 | 108 | 90 | 90 | 84 | 84 | 95 | 95 | 106 | 106 | |
| 5 | 69 | 69 | 69 | 69 | 80 | 80 | 95 | 95 | 90 | 90 | 84 | 84 | 95 | 95 | 106 | 106 | |
| 6 | 61 | 61 | 69 | 69 | 80 | 80 | 79 | 79 | 90 | 90 | 84 | 84 | 95 | 95 | 106 | 106 | |
| 7 | 53 | 53 | 61 | 61 | 70 | 70 | 68 | 68 | 79 | 79 | 84 | 84 | 95 | 95 | 106 | 106 | |
| 8 | 46 | 45 | 53 | 53 | 61 | 61 | 59 | 59 | 69 | 69 | 78 | 78 | 88 | 88 | 98 | 98 | .099 |
| 9 | 41 | 39 | 47 | 46 | 54 | 53 | 53 | 52 | 61 | 60 | 70 | 70 | 79 | 79 | 87 | 87 | .126 |
| 10 | 37 | 34 | 43 | 41 | 49 | 47 | 48 | 46 | 55 | 52 | 63 | 63 | 71 | 71 | 78 | 78 | .155 |
| 11 | 34 | 30 | 39 | 36 | 44 | 41 | 43 | 40 | 50 | 46 | 57 | 56 | 64 | 63 | 71 | 70 | .188 |
| 12 | 31 | 27 | 36 | 32 | 41 | 36 | 40 | 36 | 46 | 41 | 52 | 50 | 59 | 56 | 65 | 63 | .223 |
| 13 | 28 | 24 | 33 | 28 | 38 | 32 | 37 | 32 | 42 | 37 | 48 | 45 | 54 | 51 | 60 | 57 | .263 |
| 14 | 26 | 21 | 31 | 25 | 35 | 29 | 34 | 29 | 39 | 33 | 45 | 41 | 50 | 46 | 56 | 51 | .304 |
| 15 | 25 | 19 | 29 | 23 | 33 | 26 | 32 | 26 | 37 | 30 | 42 | 37 | 47 | 42 | 52 | 47 | .341 |
| 16 | 23 | 17 | 27 | 21 | 31 | 24 | 30 | 23 | 34 | 27 | 39 | 34 | 44 | 38 | 49 | 43 | .398 |
| 17 | 22 | 15 | 25 | 19 | 29 | 21 | 28 | 21 | 32 | 24 | 37 | 31 | 42 | 35 | 46 | 39 | .449 |
| 18 | 21 | 14 | 24 | 17 | 27 | 20 | 26 | 19 | 31 | 22 | 35 | 28 | 39 | 32 | 44 | 36 | .503 |
| 19 | 19 | 13 | 23 | 16 | 26 | 18 | 25 | 18 | 29 | 20 | 33 | 26 | 37 | 30 | 41 | 33 | .560 |
| 20 | 18 | 11 | 21 | 14 | 24 | 16 | 24 | 16 | 28 | 18 | 31 | 24 | 35 | 27 | 39 | 30 | .621 |
| 21 | 18 | ... | 20 | 13 | 23 | 15 | 23 | 15 | 26 | 17 | 30 | 22 | 34 | 25 | 37 | 28 | .684 |
| 22 | 17 | ... | 19 | ... | 22 | ... | 22 | ... | 25 | ... | 29 | ... | 32 | ... | 36 | ... | .751 |
| 23 | 16 | ... | 19 | ... | 21 | ... | 21 | ... | 24 | ... | 27 | ... | 31 | ... | 34 | ... | .822 |
| 24 | 15 | ... | 18 | ... | 20 | ... | 20 | ... | 23 | ... | 26 | ... | 29 | ... | 33 | ... | .894 |
| 25 | 15 | ... | 17 | ... | 19 | ... | 19 | ... | 22 | ... | 25 | ... | 28 | ... | 31 | ... | .970 |

* Special Sections. Web Thickness ⅜".




# CARNEGIE BEAMS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 12″ C

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 12.000 | | 12.118 | | 12.260 | | 12.000 | | 12.000 | | 12.000 | |
| Wt. per foot. | | 55.0 | | 60 0 | | 66.0 | | 65.0 | | 70.0 | | 76.0 | |
| Area sq. in. | | 16.17 | | 17.65 | | 19.41 | | 19.11 | | 20.58 | | 22.35 | |
| b″ | | 9 000 | | 9.034 | | 9.073 | | 12.000 | | 12.123 | | 12.270 | |
| t | | .375 | | .409 | | .448 | | .400 | | .523 | | .670 | |
| h | | 10⅝ | | 10⅝ | | 10⅝ | | 10¾ | | 10¾ | | 10¾ | |
| m | | .665 | | .724 | | .795 | | .608 | | .608 | | .608 | |
| k | | 3¾ | | 3¾ | | 3¾ | | 5¼ | | 5¼ | | 5¼ | |
| f | | .55 | | .55 | | .55 | | .55 | | .55 | | .55 | |
| c | | 9½ | | 9½ | | 9½ | | 9⅝ | | 9⅝ | | 9⅝ | |
| g | | 5½ | | 5½ | | 5½ | | 7½ | | 7½ | | 7½ | |
| AXES X-X | I | 428.4 | | 472.0 | | 525.7 | | 521.3 | | 539.0 | | 560.2 | |
| | S | 71.40 | | 77.90 | | 85.76 | | 86.88 | | 89.83 | | 93.36 | |
| | r | 5.15 | | 5.17 | | 5.20 | | 5.22 | | 5.12 | | 5.01 | |
| AXES Y-Y | I | 80.9 | | 89.0 | | 99.1 | | 175.2 | | 180.7 | | 187.5 | |
| | S | 18.0 | | 19.7 | | 21.8 | | 29.2 | | 29.8 | | 30.6 | |
| | r | 2.24 | | 2.25 | | 2.26 | | 3.03 | | 2.96 | | 2.90 | |
| Coef. Str. | | 856800 | | 934800 | | 1029100 | | 1042600 | | 1078000 | | 1120400 | |
| Max. Mom. "# | | 1285200 | | 1402200 | | 1543700 | | 1563900 | | 1617000 | | 1680600 | |
| V | | 54000 | | 59500 | | 65900 | | 57600 | | 75300 | | 96500 | |
| P. feet | | 7 93 | | 7.86 | | 7.81 | | 9.05 | | 7.16 | | 5.80 | |
| R | | 36560 | | 40060 | | 44120 | | 39000 | | 50990 | | 65300 | |
| W | | 50640 | | 55220 | | 60480 | | 54000 | | 70610 | | 71580 | |
| Q. feet | | 8.46 | | 8.46 | | 8.51 | | 9.65 | | 7.63 | | 7.83 | |
| w. lbs. | | 24 | | 24 | | 24 | | 24 | | 24 | | 24 | |
| Rivet dia. | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ | | ⅞ | |

Live Load Deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Total Deflection in inches for Maximum Load; Laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 108 | 108 | 119 | 119 | 132 | 132 | 115 | 115 | 151 | 151 | 193 | 193 | |
| 4 | 108 | 108 | 119 | 119 | 132 | 132 | 115 | 115 | 151 | 151 | 193 | 193 | |
| 5 | 108 | 108 | 119 | 119 | 132 | 132 | 115 | 115 | 151 | 151 | 193 | 193 | |
| 6 | 108 | 108 | 119 | 119 | 132 | 132 | 115 | 115 | 151 | 151 | 187 | 187 | |
| 7 | 108 | 108 | 119 | 119 | 132 | 132 | 115 | 115 | 151 | 151 | 160 | 160 | |
| 8 | 107 | 107 | 117 | 117 | 129 | 129 | 115 | 115 | 135 | 135 | 140 | 140 | .099 |
| 9 | 95 | 95 | 104 | 104 | 114 | 114 | 115 | 115 | 120 | 120 | 124 | 124 | .126 |
| 10 | 86 | 86 | 93 | 93 | 103 | 103 | 104 | 104 | 108 | 108 | 112 | 112 | .155 |
| 11 | 78 | 78 | 85 | 85 | 94 | 94 | 95 | 95 | 98 | 98 | 102 | 102 | .188 |
| 12 | 71 | 70 | 78 | 77 | 86 | 85 | 87 | 87 | 90 | 90 | 93 | 93 | .223 |
| 13 | 66 | 64 | 72 | 70 | 79 | 77 | 80 | 80 | 83 | 83 | 86 | 86 | .263 |
| 14 | 61 | 58 | 67 | 63 | 74 | 70 | 75 | 75 | 77 | 77 | 80 | 80 | .304 |
| 15 | 57 | 53 | 62 | 58 | 69 | 64 | 70 | 70 | 72 | 72 | 75 | 75 | .341 |
| 16 | 54 | 49 | 58 | 53 | 64 | 58 | 65 | 64 | 67 | 67 | 70 | 69 | .398 |
| 17 | 50 | 45 | 55 | 49 | 61 | 54 | 61 | 60 | 63 | 62 | 66 | 64 | .449 |
| 18 | 48 | 41 | 52 | 45 | 57 | 50 | 58 | 55 | 60 | 58 | 62 | 60 | .503 |
| 19 | 45 | 38 | 49 | 41 | 54 | 46 | 55 | 52 | 57 | 54 | 59 | 56 | .560 |
| 20 | 43 | 35 | 47 | 38 | 51 | 42 | 52 | 48 | 54 | 50 | 56 | 52 | .621 |
| 21 | 41 | 33 | 45 | 36 | 49 | 39 | 50 | 45 | 51 | 47 | 53 | 49 | .684 |
| 22 | 39 | .. | 43 | .. | 47 | .. | 47 | .. | 49 | .. | 51 | .. | .751 |
| 23 | 37 | .. | 41 | .. | 45 | .. | 45 | .. | 47 | .. | 49 | .. | .822 |
| 24 | 36 | .. | 39 | .. | 43 | .. | 43 | .. | 45 | .. | 47 | .. | .894 |
| 25 | 34 | .. | 37 | .. | 41 | .. | 42 | .. | 43 | .. | 45 | .. | .970 |

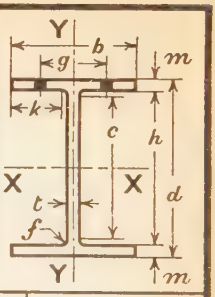
# 14″ C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth – d″. | 13 964 | 14 000 | 14 080 | *14 000 | 14 160 | 14 240 |
| Wt. per foot. | 30.0 | 33 0 | 36.0 | 38 0 | 39 0 | 42 0 |
| Area | 8.82 | 9 71 | 10 58 | 11.18 | 11.47 | 12 35 |
| b″ | 6.000 | 6.750 | 6.774 | 6.855 | 6.798 | 6.822 |
| t | .270 | 270 | .294 | 375 | .318 | .342 |
| h | 13 1/16 | 13 1/16 | 13 1/16 | 13 1/16 | 13 1/16 | 13 1/16 |
| m | .431 | 449 | 489 | 449 | .529 | .569 |
| k | 2 7/16 | 2 13/16 | 2 13/16 | 2 13/16 | 2 13/16 | 2 13/16 |
| f | .40 | .40 | .40 | 40 | .40 | 40 |
| c | 12 1/4 | 12 1/4 | 12 1/4 | 12 1/4 | 12 1/4 | 12 1/4 |
| g | 3″ | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2 |
| AXES X-X I | 292 0 | 333.4 | 365.6 | 357.5 | 398.3 | 431.5 |
| AXES X-X S | 41 82 | 47.63 | 51.93 | 51.07 | 56.26 | 60.60 |
| AXES X-X r | 5.75 | 5.86 | 5.88 | 5.66 | 5.89 | 5.91 |
| AXES Y-Y I | 15 5 | 23.0 | 25.4 | 24.2 | 27.7 | 30.2 |
| AXES Y-Y S | 5 2 | 6.8 | 7.5 | 7.1 | 8.2 | 8.8 |
| AXES Y-Y r | 1 33 | 1.54 | 1.55 | 1.47 | 1.56 | 1.56 |
| Coef. Str. | 501900 | 571500 | 623200 | 612900 | 675100 | 727200 |
| Max. Mom.″# | 752800 | 857300 | 934800 | 919300 | 1012600 | 1090900 |
| V | 45200 | 45400 | 49700 | 63000 | 54000 | 58400 |
| P. feet | 5 54 | 6 30 | 6 27 | 4 87 | 6 25 | 6 22 |
| R | 23500 | 23490 | 26880 | 38340 | 30290 | 33720 |
| W | 24300 | 24300 | 26460 | 33750 | 28620 | 30780 |
| Q. feet | 10 32 | 11 75 | 11 78 | 9 08 | 11 79 | 11 81 |
| w lbs. | 19 | 19 | 19 | 19 | 19 | 19 |
| Rivet dia. | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 |

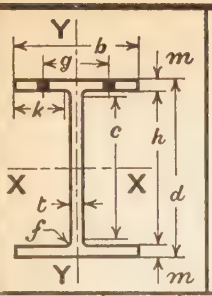
Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 91 | 91 | 91 | 91 | 99 | 99 | 126 | 126 | 108 | 108 | 117 | 117 | |
| 5 | 91 | 91 | 91 | 91 | 99 | 99 | 123 | 123 | 108 | 108 | 117 | 117 | |
| 6 | 84 | 84 | 91 | 91 | 99 | 99 | 102 | 102 | 108 | 108 | 117 | 117 | |
| 7 | 72 | 72 | 82 | 82 | 89 | 89 | 88 | 88 | 96 | 96 | 104 | 104 | .065 |
| 8 | 63 | 62 | 72 | 72 | 78 | 78 | 77 | 77 | 84 | 84 | 91 | 91 | .085 |
| 9 | 56 | 53 | 64 | 63 | 69 | 68 | 68 | 67 | 75 | 74 | 81 | 80 | .108 |
| 10 | 50 | 47 | 57 | 55 | 62 | 60 | 61 | 59 | 68 | 65 | 73 | 70 | .133 |
| 11 | 46 | 41 | 52 | 49 | 57 | 53 | 56 | 52 | 61 | 57 | 66 | 62 | .161 |
| 12 | 42 | 36 | 48 | 43 | 52 | 47 | 51 | 47 | 56 | 51 | 61 | 55 | .192 |
| 13 | 39 | 32 | 44 | 39 | 48 | 42 | 47 | 42 | 52 | 46 | 56 | 49 | .225 |
| 14 | 36 | 29 | 41 | 35 | 45 | 38 | 44 | 37 | 48 | 41 | 52 | 44 | .261 |
| 15 | 34 | 26 | 38 | 31 | 42 | 34 | 41 | 34 | 45 | 37 | 49 | 40 | .299 |
| 16 | 31 | 23 | 36 | 28 | 39 | 31 | 38 | 31 | 42 | 34 | 46 | 36 | .341 |
| 17 | 32 | 21 | 34 | 26 | 37 | 28 | 36 | 28 | 40 | 30 | 43 | 33 | .384 |
| 18 | 28 | 19 | 32 | 23 | 35 | 25 | 34 | 25 | 38 | 28 | 40 | 30 | .431 |
| 19 | 26 | 17 | 30 | 21 | 33 | 23 | 32 | 23 | 36 | 25 | 38 | 27 | .480 |
| 20 | 25 | 16 | 29 | 20 | 31 | 21 | 31 | 21 | 34 | 23 | 36 | 25 | .532 |
| 21 | 24 | .. | 27 | 18 | 30 | 20 | 29 | 19 | 32 | 21 | 35 | 23 | .587 |
| 22 | 23 | .. | 26 | 16 | 28 | 18 | 28 | 18 | 31 | 20 | 33 | 21 | .644 |
| 23 | 22 | .. | 25 | ... | 27 | ... | 27 | ... | 29 | ... | 32 | ... | .704 |
| 24 | 21 | ... | 24 | ... | 26 | ... | 26 | ... | 28 | ... | 30 | ... | .766 |
| 25 | 20 | ... | 23 | . | 25 | ... | 25 | ... | 27 | ... | 29 | ... | .831 |
| 26 | 19 | ... | 22 | .. | 24 | .. | 24 | ... | 26 | ... | 28 | ... | .899 |
| 27 | 19 | .. | 21 | .. | 23 | ... | 23 | ... | 25 | ... | 27 | ... | .970 |
| 28 | 18 | .. | 20 | .. | 22 | ... | 22 | ... | 24 | .. | 26 | ... | 1.043 |
| 29 | 17 | .. | 20 | . | 21 | ... | 21 | ... | 23 | ... | 25 | ... | 1.119 |
| 30 | 17 | .. | 19 | .. | 21 | .. | 20 | ... | 23 | ... | 24 | ... | 1.197 |

* Special Section. Web Thickness 3/8″.




# CARNEGIE BEAMS

## 14" C

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration

V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d". | | 14.000 | 14.122 | 14.242 | 14.094 | 14 238 | 14.382 | 14.000 | 14.186 | 14.370 |
| Wt. per foot. | | 48.0 | 53.0 | 58.0 | 61.0 | 68.0 | 75.0 | 85 0 | 95.0 | 105.0 |
| Area | | 14.12 | 15.59 | 17.05 | 17.94 | 19.99 | 22.05 | 24.99 | 27.93 | 30.88 |
| b" | | 8.000 | 8.035 | 8.070 | 10 000 | 10.043 | 10.086 | 12.000 | 12.050 | 12.101 |
| t | | .343 | .378 | .413 | .382 | .425 | .468 | .435 | .485 | .536 |
| h | | 12 3/4 | 12 3/4 | 12 3/4 | 12 3/4 | 12 3/4 | 12 3/4 | 12 3/8 | 12 3/8 | 12 3/8 |
| m | | .595 | .656 | .716 | .642 | .714 | .786 | .805 | .898 | .990 |
| k | | 3 1/4 | 3 1/4 | 3 1/4 | 4 1/4 | 4 1/4 | 4 1/4 | 5 1/8 | 5 1/8 | 5 1/8 |
| f | | .55 | .55 | .55 | .55 | .55 | .55 | .65 | .65 | .65 |
| c | | 11 5/8 | 11 5/8 | 11 5/8 | 11 5/8 | 11 5/8 | 11 5/8 | 11" | 11" | 11" |
| g | | 4" | 4" | 4" | 5½ | 5½ | 5½ | 7½ | 7½ | 7½ |
| AXES X-X | I | 496.0 | 552.5 | 609.4 | 656.2 | 738.8 | 823.5 | 921.3 | 1044.0 | 1169.6 |
| | S | 70.86 | 78.25 | 85.58 | 93.12 | 103.78 | 114.52 | 131.61 | 147.19 | 162.78 |
| | r | 5.93 | 5.95 | 5.98 | 6.05 | 6.08 | 6.11 | 6.07 | 6.11 | 6.15 |
| AXES Y-Y | I | 50.8 | 56.8 | 62 8 | 107.1 | 120.6 | 134.5 | 232 0 | 262.0 | 292.6 |
| | S | 12.7 | 14.1 | 15.6 | 21.4 | 24.0 | 26.7 | 38.7 | 43.5 | 48.4 |
| | r | 1.90 | 1 91 | 1.92 | 2.44 | 2.46 | 2.47 | 3.05 | 3.06 | 3.08 |
| Coef. Str. | | 850300 | 939000 | 1026900 | 1117400 | 1245300 | 1374200 | 1579400 | 1766200 | 1953400 |
| Max. Mom."# | | 1275400 | 1408400 | 1540400 | 1676100 | 1868000 | 2061300 | 2369100 | 2649400 | 2930100 |
| V | | 57600 | 64100 | 70600 | 64600 | 72600 | 80800 | 73100 | 82600 | 92400 |
| P. feet | | 7 38 | 7 32 | 7 28 | 8 65 | 8 58 | 8 51 | 10 80 | 10 70 | 10 57 |
| R | | 33820 | 38810 | 43740 | 39360 | 45000 | 49810 | 45670 | 51260 | 57020 |
| W | | 46300 | 51030 | 55760 | 51570 | 57370 | 63180 | 58730 | 65470 | 71580 |
| Q. feet | | 9 18 | 9 20 | 9 21 | 10 83 | 10 85 | 10 88 | 13 45 | 13 49 | 13 64 |
| w. lbs. | | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Rivet dia | | 7/8 | 7/8 | 7/8 | 1" | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 115 | 115 | 128 | 128 | 141 | 141 | 129 | 129 | 145 | 145 | 162 | 162 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 5 | 115 | 115 | 128 | 128 | 141 | 141 | 129 | 129 | 145 | 145 | 162 | 162 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 6 | 115 | 115 | 128 | 128 | 141 | 141 | 129 | 129 | 145 | 145 | 162 | 162 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 7 | 115 | 115 | 128 | 128 | 141 | 141 | 129 | 129 | 145 | 145 | 162 | 162 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 8 | 106 | 106 | 117 | 117 | 128 | 128 | 129 | 129 | 145 | 145 | 162 | 162 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 9 | 95 | 95 | 104 | 104 | 114 | 114 | 124 | 124 | 138 | 138 | 153 | 153 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 10 | 85 | 85 | 94 | 94 | 103 | 103 | 112 | 112 | 125 | 125 | 137 | 137 | 146 | 146 | 165 | 165 | 185 | 185 | |
| 11 | 77 | 76 | 85 | 84 | 93 | 92 | 102 | 102 | 113 | 113 | 125 | 125 | 144 | 144 | 161 | 161 | 178 | 178 | .161 |
| 12 | 71 | 68 | 78 | 75 | 86 | 82 | 93 | 93 | 104 | 104 | 115 | 115 | 132 | 132 | 147 | 147 | 163 | 163 | .192 |
| 13 | 65 | 61 | 72 | 67 | 79 | 74 | 86 | 85 | 96 | 95 | 106 | 105 | 122 | 122 | 136 | 136 | 150 | 150 | .225 |
| 14 | 61 | 55 | 67 | 61 | 73 | 67 | 80 | 78 | 89 | 87 | 98 | 96 | 113 | 113 | 126 | 126 | 140 | 140 | .261 |
| 15 | 57 | 50 | 63 | 56 | 69 | 61 | 75 | 71 | 83 | 79 | 92 | 88 | 105 | 105 | 118 | 118 | 130 | 130 | .299 |
| 16 | 53 | 46 | 59 | 51 | 64 | 56 | 70 | 66 | 78 | 73 | 86 | 81 | 99 | 97 | 110 | 109 | 122 | 121 | .341 |
| 17 | 50 | 42 | 55 | 46 | 60 | 51 | 66 | 60 | 73 | 68 | 81 | 75 | 93 | 90 | 104 | 101 | 115 | 112 | .384 |
| 18 | 47 | 39 | 52 | 43 | 57 | 47 | 62 | 56 | 69 | 62 | 76 | 69 | 88 | 84 | 98 | 94 | 109 | 104 | .431 |
| 19 | 45 | 35 | 49 | 39 | 54 | 43 | 59 | 52 | 66 | 58 | 72 | 64 | 83 | 78 | 93 | 88 | 103 | 97 | .480 |
| 20 | 43 | 33 | 47 | 36 | 51 | 40 | 56 | 48 | 62 | 54 | 69 | 60 | 79 | 73 | 88 | 82 | 98 | 91 | .532 |
| 21 | 41 | 30 | 45 | 33 | 49 | 37 | 53 | 45 | 59 | 50 | 65 | 55 | 75 | 69 | 84 | 77 | 93 | 85 | .587 |
| 22 | 39 | 28 | 43 | 31 | 47 | 34 | 51 | 42 | 57 | 47 | 63 | 52 | 72 | 64 | 80 | 72 | 89 | 80 | .644 |
| 23 | 37 | 26 | 41 | 29 | 45 | 31 | 49 | 39 | 54 | 44 | 60 | 48 | 69 | 60 | 77 | 68 | 85 | 75 | .704 |
| 24 | 35 | 24 | 39 | 27 | 43 | 29 | 47 | 37 | 52 | 41 | 57 | 45 | 66 | 57 | 74 | 64 | 81 | 71 | .766 |
| 25 | 34 | 22 | 38 | 25 | 41 | 27 | 45 | 34 | 50 | 38 | 55 | 42 | 63 | 54 | 71 | 60 | 78 | 67 | .831 |
| 26 | 33 | ... | 36 | .. | 40 | ... | 43 | ... | 48 | . | 53 | . | 61 | .. | 68 | .. | 75 | .. | .899 |
| 27 | 32 | ... | 35 | ... | 38 | ... | 41 | ... | 46 | .. | 51 | .. | 59 | ... | 65 | ... | 72 | ... | .970 |
| 28 | 30 | ... | 34 | .. | 37 | ... | 40 | . | 45 | ... | 49 | ... | 56 | ... | 63 | .. | 70 | ... | 1.043 |
| 29 | 29 | ... | 32 | .. | 35 | .. | 39 | ... | 43 | ... | 47 | ... | 54 | ... | 61 | ... | 67 | ... | 1 119 |
| 30 | 28 | .. | 31 | .. | 34 | ... | 37 | . | 42 | ... | 46 | ... | 53 | . | 59 | . | 65 | ... | 1.197 |

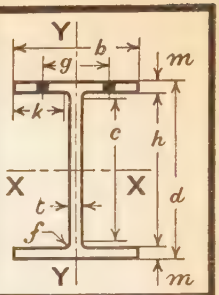
# 16″ C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | 15.930 | 16.012 | 16.000 | *15.934 | 16.128 | 16.254 | 16 000 | 16 114 | 16 226 | | |
| Wt. per foot. | 35.0 | 38.0 | 40.0 | 43.0 | 45.0 | 50.0 | 58.0 | 63.0 | 68 0 | | |
| Area | 10.29 | 11.17 | 11.75 | 12.65 | 13.23 | 14.70 | 17.06 | 18.52 | 20.00 | | |
| b″ | 6.000 | 6.024 | 7.000 | 7.085 | 7.036 | 7.072 | 8.500 | 8.531 | 8.563 | | |
| t | .290 | .314 | .290 | .375 | .326 | .362 | .375 | .406 | .438 | | |
| h | 14 15/16 | 14 15/16 | 14 15/16 | 14 15/16 | 14 15/16 | 14 15/16 | 14 5/8 | 14 5/8 | 14 5/8 | | |
| m | .485 | .526 | .520 | .487 | .584 | .647 | .663 | .720 | .776 | | |
| k | 2 3/8 | 2 3/8 | 2 7/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 7/16 | 3 7/16 | 3 7/16 | | |
| f | .45 | .45 | .45 | .45 | .45 | .45 | .65 | .65 | .65 | | |
| c | 14″ | 14″ | 14″ | 14″ | 14″ | 14″ | 13 3/8 | 13 3/8 | 13 3/8 | | |
| g | 3″ | 3″ | 4″ | 4″ | 4″ | 4″ | 5½ | 5½ | 5½ | | |
| AXES X-X I | 435.5 | 475.1 | 524.6 | 523.8 | 595.0 | 666.0 | 776.6 | 849.9 | 923.7 | | |
| AXES X-X S | 54.68 | 59.34 | 65.58 | 65.75 | 73.78 | 81.95 | 97.08 | 105.49 | 113.85 | | |
| AXES X-X r | 6.50 | 6.52 | 6.68 | 6.44 | 6.71 | 6.73 | 6.75 | 6.77 | 6.80 | | |
| AXES Y-Y I | 17.5 | 19.2 | 29.8 | 28.9 | 34.0 | 38.2 | 68.0 | 74.6 | 81.3 | | |
| AXES Y-Y S | 5.8 | 6.4 | 8.5 | 8.2 | 9.7 | 10.8 | 16.0 | 17.5 | 19.0 | | |
| AXES Y-Y r | 1.30 | 1.31 | 1.59 | 1.51 | 1.60 | 1.61 | 2 00 | 2 01 | 2 02 | | |
| Coef. Str. | 656100 | 712100 | 786900 | 789000 | 885400 | 983400 | 1164900 | 1265800 | 1366200 | | |
| Max.Mom.″# | 984200 | 1068200 | 1180400 | 1183400 | 1328100 | 1475100 | 1747400 | 1898700 | 2049400 | | |
| V | 55400 | 60300 | 55700 | 71700 | 63100 | 70600 | 72000 | 78500 | 85300 | | |
| P. feet | 5.92 | 5.90 | 7.07 | 5.50 | 7 02 | 6 96 | 8 09 | 8 06 | 8.01 | | |
| R | 25990 | 29590 | 25970 | 38830 | 31390 | 36890 | 38840 | 43580 | 48480 | | |
| W | 26100 | 28260 | 26100 | 33750 | 29340 | 32580 | 67500 | 73080 | 78840 | | |
| Q. feet | 12.56 | 12.59 | 15.06 | 11.69 | 15 09 | 15.09 | 8.63 | 8.66 | 8.66 | | |
| w lbs | 19 | 19 | 19 | 19 | 19 | 19 | 33 | 33 | 33 | | |
| Rivet dia | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ | | |

Live Load deflection must not exceed 1/360 of the Span.

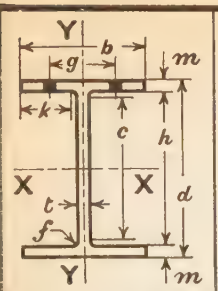
Live Load Def. = Total Def. × Live Load / Tabular Load

Total Deflection in inches for Maximum Load; Laterally fixed beam.

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 111 | 111 | 121 | 121 | 111 | 111 | 143 | 143 | 126 | 126 | 141 | 141 | 144 | 144 | 157 | 157 | 171 | 171 | |
| 6 | 109 | 109 | 118 | 118 | 111 | 111 | 132 | 132 | 126 | 126 | 141 | 141 | 144 | 144 | 157 | 157 | 171 | 171 | |
| 7 | 94 | 94 | 102 | 102 | 111 | 111 | 113 | 113 | 126 | 126 | 140 | 140 | 144 | 144 | 157 | 157 | 171 | 171 | |
| 8 | 82 | 81 | 89 | 88 | 98 | 98 | 99 | 99 | 111 | 111 | 123 | 123 | 144 | 144 | 157 | 157 | 171 | 171 | |
| 9 | 73 | 70 | 79 | 76 | 87 | 87 | 88 | 87 | 98 | 98 | 109 | 109 | 129 | 129 | 141 | 141 | 152 | 152 | .094 |
| 10 | 66 | 61 | 71 | 66 | 79 | 77 | 79 | 77 | 89 | 86 | 98 | 95 | 117 | 117 | 127 | 127 | 137 | 137 | 116 |
| 11 | 60 | 53 | 65 | 58 | 72 | 68 | 72 | 68 | 80 | 76 | 89 | 84 | 106 | 105 | 115 | 114 | 124 | 123 | .141 |
| 12 | 55 | 47 | 59 | 51 | 66 | 61 | 66 | 61 | 74 | 68 | 82 | 76 | 97 | 94 | 106 | 102 | 114 | 111 | .168 |
| 13 | 51 | 42 | 55 | 45 | 61 | 54 | 61 | 54 | 68 | 61 | 76 | 68 | 90 | 85 | 97 | 93 | 105 | 100 | .197 |
| 14 | 47 | 37 | 51 | 41 | 56 | 48 | 56 | 49 | 63 | 54 | 70 | 61 | 83 | 77 | 90 | 84 | 98 | 91 | .228 |
| 15 | 44 | 34 | 47 | 36 | 52 | 43 | 53 | 42 | 59 | 49 | 66 | 55 | 78 | 70 | 84 | 77 | 91 | 83 | .262 |
| 16 | 41 | 30 | 44 | 33 | 49 | 40 | 49 | 40 | 55 | 45 | 61 | 50 | 73 | 65 | 79 | 70 | 85 | 76 | .298 |
| 17 | 39 | 27 | 42 | 30 | 46 | 36 | 47 | 37 | 52 | 41 | 58 | 46 | 69 | 59 | 75 | 64 | 80 | 70 | .336 |
| 18 | 37 | 25 | 40 | 27 | 44 | 33 | 44 | 33 | 49 | 37 | 55 | 42 | 65 | 54 | 70 | 59 | 76 | 64 | .377 |
| 19 | 35 | 22 | 37 | 24 | 41 | 30 | 42 | 30 | 47 | 34 | 52 | 38 | 61 | 50 | 67 | 55 | 72 | 59 | .420 |
| 20 | 33 | 20 | 36 | 22 | 39 | 27 | 40 | 28 | 44 | 31 | 49 | 35 | 58 | 46 | 63 | 50 | 68 | 55 | .466 |
| 21 | 31 | ... | 34 | ... | 37 | 25 | 38 | 26 | 42 | 28 | 47 | 32 | 56 | 43 | 60 | 47 | 65 | 50 | .513 |
| 22 | 30 | ... | 32 | ... | 36 | 23 | 36 | 24 | 40 | 26 | 45 | 29 | 53 | 40 | 58 | 43 | 62 | 47 | .563 |
| 23 | 29 | ... | 31 | ... | 34 | 21 | 34 | 22 | 38 | 24 | 43 | 27 | 51 | 37 | 55 | 40 | 59 | 43 | .616 |
| 24 | 27 | ... | 30 | ... | 33 | ... | 33 | ... | 37 | ... | 41 | ... | 49 | 34 | 53 | 37 | 57 | 40 | .670 |
| 25 | 26 | ... | 28 | ... | 31 | ... | 32 | ... | 35 | ... | 39 | ... | 47 | 32 | 51 | 35 | 55 | 38 | .727 |
| 26 | 25 | ... | 27 | ... | 30 | ... | 30 | ... | 34 | ... | 38 | ... | 45 | 30 | 49 | 33 | 53 | 35 | .787 |
| 27 | 24 | ... | 26 | ... | 29 | ... | 29 | ... | 33 | ... | 36 | ... | 43 | 28 | 47 | 30 | 51 | 33 | .848 |
| 28 | 24 | ... | 25 | ... | 28 | ... | 28 | ... | 32 | ... | 35 | ... | 42 | 26 | 45 | 28 | 49 | 31 | .912 |
| 29 | 23 | ... | 25 | ... | 27 | ... | 27 | ... | 31 | ... | 34 | ... | 40 | ... | 44 | ... | 47 | ... | .979 |
| 30 | 22 | ... | 24 | ... | 26 | ... | 26 | ... | 30 | ... | 33 | ... | 39 | ... | 42 | ... | 46 | ... | 1.047 |
| 31 | 21 | ... | 23 | ... | 25 | ... | 26 | ... | 29 | ... | 32 | ... | 38 | ... | 41 | ... | 44 | ... | 1.118 |
| 32 | 21 | ... | 22 | ... | 25 | ... | 25 | ... | 28 | ... | 31 | ... | 36 | ... | 40 | ... | 43 | ... | 1.192 |
| 33 | 20 | ... | 22 | ... | 24 | ... | 24 | ... | 27 | ... | 30 | ... | 35 | ... | 38 | ... | 41 | ... | 1.267 |

* Special Section. Web Thickness 3/8″




# CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 16″ C

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″ | | 16.000 | | 16.120 | | 16.240 | | 16.000 | | 16.110 | | 16 236 | |
| Wt. per foot | | 76.0 | | 83.0 | | 90.0 | | 100 0 | | 107.0 | | 115 0 | |
| Area | | 22.34 | | 24.41 | | 26.46 | | 29.41 | | 31.46 | | 33 82 | |
| b″ | | 12.000 | | 12.039 | | 12.076 | | 14.000 | | 14.032 | | 14.068 | |
| t | | .419 | | .458 | | .495 | | .464 | | .496 | | .532 | |
| h | | 14⅝ | | 14⅝ | | 14⅝ | | 14⅜ | | 14⅜ | | 14⅜ | |
| m | | .663 | | .723 | | .783 | | .800 | | .855 | | .918 | |
| k | | 5⅛ | | 5⅛ | | 5⅛ | | 6 1/16 | | 6 1/16 | | 6 1/16 | |
| f | | .65 | | .65 | | .65 | | .70 | | .70 | | .70 | |
| c | | 13⅜ | | 13⅜ | | 13⅜ | | 13″ | | 13″ | | 13″ | |
| g | | 7½ | | 7½ | | 7½ | | 10″ | | 10″ | | 10″ | |
| AXES X-X | I | 1061.3 | | 1167.7 | | 1275.5 | | 1426.8 | | 1537.2 | | 1665.6 | |
| | S | 132.66 | | 144.88 | | 157.08 | | 178.35 | | 190.84 | | 205.17 | |
| | r | 6.89 | | 6.92 | | 6.94 | | 6.97 | | 6.99 | | 7.02 | |
| AXES Y-Y | I | 191.1 | | 210.4 | | 230.0 | | 366.0 | | 393.9 | | 426.2 | |
| | S | 31.8 | | 35.0 | | 38.1 | | 52.3 | | 56.1 | | 60.6 | |
| | r | 2.92 | | 2.94 | | 2.95 | | 3.53 | | 3.54 | | 3.55 | |
| Coef. Str. | | 1591900 | | 1738500 | | 1885000 | | 2140200 | | 2290000 | | 2462100 | |
| Max. Mom. ″/# | | 2387900 | | 2607800 | | 2827500 | | 3210300 | | 3435100 | | 3693100 | |
| V | | 80500 | | 88600 | | 96500 | | 89100 | | 95900 | | 103700 | |
| P. feet | | 9 90 | | 9.81 | | 9.77 | | 12 01 | | 11.94 | | 11 88 | |
| R | | 45510 | | 51450 | | 56130 | | 52200 | | 56000 | | 60320 | |
| W | | 75420 | | 82440 | | 89100 | | 83520 | | 89280 | | 95440 | |
| Q. feet | | 10.55 | | 10.54 | | 10.58 | | 12.81 | | 12.82 | | 12.90 | |
| w lbs. | | 33 | | 33 | | 33 | | 33 | | 33 | | 33 | |
| Rivet dia | | 1″ | | 1″ | | 1″ | | 1″ | | 1″ | | 1″ | |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 161 | 161 | 177 | 177 | 193 | 193 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 6 | 161 | 161 | 177 | 177 | 193 | 193 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 7 | 161 | 161 | 177 | 177 | 193 | 193 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 8 | 161 | 161 | 177 | 177 | 193 | 193 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 9 | 161 | 161 | 177 | 177 | 193 | 193 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 10 | 159 | 159 | 174 | 174 | 189 | 189 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 11 | 145 | 145 | 158 | 158 | 171 | 171 | 178 | 178 | 192 | 192 | 207 | 207 | |
| 12 | 133 | 133 | 145 | 145 | 157 | 157 | 178 | 178 | 191 | 191 | 205 | 205 | |
| 13 | 123 | 123 | 134 | 134 | 145 | 145 | 165 | 165 | 176 | 176 | 189 | 189 | .197 |
| 14 | 114 | 114 | 124 | 124 | 135 | 135 | 153 | 153 | 164 | 164 | 176 | 176 | .228 |
| 15 | 106 | 106 | 116 | 116 | 126 | 126 | 143 | 143 | 153 | 153 | 164 | 164 | .262 |
| 16 | 100 | 98 | 109 | 107 | 118 | 116 | 134 | 134 | 143 | 143 | 154 | 154 | .298 |
| 17 | 94 | 91 | 102 | 99 | 111 | 108 | 126 | 126 | 135 | 135 | 145 | 145 | .336 |
| 18 | 88 | 85 | 97 | 92 | 105 | 100 | 119 | 118 | 127 | 126 | 137 | 136 | .377 |
| 19 | 84 | 79 | 92 | 86 | 99 | 93 | 113 | 111 | 121 | 118 | 130 | 127 | .420 |
| 20 | 80 | 74 | 87 | 81 | 94 | 88 | 107 | 103 | 114 | 111 | 123 | 120 | .466 |
| 21 | 76 | 69 | 83 | 75 | 90 | 82 | 102 | 97 | 109 | 104 | 117 | 112 | .513 |
| 22 | 72 | 65 | 79 | 71 | 86 | 77 | 97 | 92 | 104 | 98 | 112 | 106 | .563 |
| 23 | 69 | 61 | 76 | 66 | 82 | 72 | 93 | 87 | 100 | 93 | 107 | 100 | .616 |
| 24 | 66 | 57 | 72 | 63 | 79 | 68 | 89 | 82 | 95 | 88 | 103 | 94 | .670 |
| 25 | 64 | 54 | 70 | 59 | 75 | 64 | 86 | 77 | 92 | 83 | 98 | 89 | .727 |
| 26 | 61 | 51 | 67 | 56 | 73 | 61 | 82 | 73 | 88 | 78 | 95 | 84 | .787 |
| 27 | 59 | 48 | 64 | 52 | 70 | 57 | 79 | 69 | 85 | 75 | 91 | 80 | .848 |
| 28 | 57 | 45 | 62 | 50 | 67 | 54 | 76 | 66 | 82 | 71 | 88 | 76 | .912 |
| 29 | 55 | ... | 60 | .. | 65 | 51 | 74 | . | 79 | .. | 85 | 72 | .979 |
| 30 | 53 | ... | 58 | ... | 63 | . | 71 | . | 76 | ... | 82 | .. | 1.047 |
| 31 | 51 | .. | 56 | .. | 61 | . | 69 | . | 74 | ... | 79 | ... | 1.118 |
| 32 | 50 | .. | 54 | ... | 59 | .. | 67 | ... | 72 | ... | 77 | ... | 1.192 |
| 33 | 48 | ... | 53 | .. | 57 | . | 65 | ... | 69 | ... | 75 | ... | 1.267 |
| 34 | 47 | ... | 51 | .. | 55 | | 63 | | 67 | ... | 72 | ... | 1.345 |

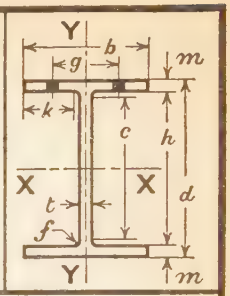
# 18" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | | | |
|---|---|---|---|---|---|
| Depth = d". | | 18 000 | *18 024 | 18 114 | 18 252 |
| Wt. per foot. | | 47 0 | 51 0 | 52 0 | 58 0 |
| Area | | 13 82 | 15 00 | 15.30 | 17.05 |
| b" | | 7.500 | 7 555 | 7.534 | 7 573 |
| t | | .320 | .375 | .354 | .393 |
| h | | 16⅞ | 16⅞ | 16⅞ | 16⅞ |
| m | | .550 | .562 | .607 | .676 |
| k | | 31/16 | 31/16 | 31/16 | 31/16 |
| f | | .50 | .50 | .50 | .50 |
| c | | 15⅞ | 15⅞ | 15⅞ | 15⅞ |
| g | | 3¾ | 3¾ | 3¾ | 3¾ |
| AXES X-X | I | 768 6 | 810 0 | 855.1 | 960 8 |
| | S | 85 4 | 89.88 | 94.41 | 105 28 |
| | r | 7 46 | 7.35 | 7.48 | 7 51 |
| AXES Y-Y | I | 38.7 | 40.5 | 43.3 | 49 0 |
| | S | 10.3 | 10.7 | 11.5 | 13 0 |
| | r | 1.67 | 1.64 | 1.68 | 1 70 |
| Coef. Str. | | 1024800 | 1078600 | 1133000 | 1263400 |
| Max Mom."s | | 1537200 | 1617800 | 1699400 | 1895100 |
| V | | 69100 | 81100 | 77000 | 86100 |
| P, feet | | 7 41 | 6 65 | 7.36 | 7.34 |
| R | | 30170 | 39020 | 35610 | 41950 |
| W | | 36000 | 42190 | 39830 | 44220 |
| Q, feet | | 14 23 | 12 78 | 14 22 | 14 28 |
| w lbs. | | 25 | 25 | 25 | 25 |
| Rivet dia | | ⅞ | ⅞ | ⅞ | ⅞ |

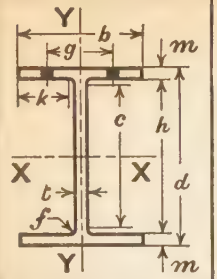
Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load, Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 138 | 138 | 162 | 162 | 154 | 154 | 172 | 172 | |
| 7 | 138 | 138 | 154 | 154 | 154 | 154 | 172 | 172 | |
| 8 | 128 | 128 | 135 | 135 | 142 | 142 | 158 | 158 | .066 |
| 9 | 114 | 114 | 120 | 120 | 126 | 126 | 140 | 140 | .084 |
| 10 | 102 | 101 | 108 | 106 | 113 | 112 | 126 | 125 | .103 |
| 11 | 93 | 90 | 98 | 94 | 103 | 99 | 115 | 111 | .125 |
| 12 | 85 | 80 | 90 | 85 | 94 | 89 | 105 | 99 | .149 |
| 13 | 79 | 72 | 83 | 76 | 87 | 80 | 97 | 89 | .175 |
| 14 | 73 | 65 | 77 | 69 | 81 | 72 | 90 | 80 | .203 |
| 15 | 68 | 59 | 72 | 62 | 76 | 65 | 84 | 73 | .233 |
| 16 | 64 | 54 | 67 | 57 | 71 | 59 | 79 | 67 | .265 |
| 17 | 60 | 49 | 63 | 52 | 67 | 54 | 74 | 61 | .299 |
| 18 | 57 | 45 | 60 | 47 | 63 | 49 | 70 | 55 | .335 |
| 19 | 54 | 41 | 57 | 43 | 60 | 45 | 66 | 51 | .373 |
| 20 | 51 | 38 | 54 | 40 | 57 | 42 | 63 | 47 | .414 |
| 21 | 49 | 35 | 51 | 37 | 54 | 38 | 60 | 43 | .456 |
| 22 | 47 | 32 | 49 | 34 | 52 | 35 | 57 | 40 | .501 |
| 23 | 45 | 30 | 47 | 31 | 49 | 33 | 55 | 37 | .548 |
| 24 | 43 | 27 | 45 | 29 | 47 | 30 | 53 | 34 | .596 |
| 25 | 41 | 25 | 43 | 27 | 45 | 28 | 51 | 32 | .647 |
| 26 | 39 | ... | 41 | ... | 44 | ... | 49 | ... | .699 |
| 27 | 38 | ... | 40 | ... | 42 | ... | 47 | ... | .754 |
| 28 | 37 | ... | 39 | ... | 40 | ... | 45 | ... | .811 |
| 29 | 35 | ... | 37 | ... | 39 | ... | 44 | ... | .870 |
| 30 | 34 | ... | 36 | ... | 38 | ... | 42 | ... | .931 |
| 31 | 33 | ... | 35 | ... | 37 | ... | 41 | ... | .994 |
| 32 | 32 | ... | 34 | ... | 35 | ... | 39 | ... | 1.06 |
| 33 | 31 | ... | 33 | ... | 34 | ... | 38 | ... | 1.13 |
| 34 | 30 | ... | 32 | ... | 33 | ... | 37 | ... | 1.20 |
| 35 | 29 | ... | 31 | ... | 32 | ... | 36 | ... | 1.27 |

* Special Section. Web Thickness ⅜"




# CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 18″ C

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d″. | | 18.000 | 18.110 | 18.242 | 18.000 | 18.120 | 18.238 |
| Wt. per foot. | | 67.0 | 72.0 | 78.0 | 86.0 | 93.0 | 100.0 |
| Area | | 19.69 | 21.17 | 22.94 | 25.29 | 27.35 | 29.40 |
| b″ | | 8.500 | 8.530 | 8.565 | 12.000 | 12.034 | 12.069 |
| t | | .406 | .436 | .471 | .429 | .463 | .498 |
| h | | 16½ | 16½ | 16½ | 16½ | 16½ | 16½ |
| m | | .745 | .800 | .866 | .745 | .805 | .864 |
| k | | 3⅜ | 3⅜ | 3⅜ | 5 1/16 | 5 1/16 | 5 1/16 |
| f | | .70 | .70 | .70 | .70 | .70 | .70 |
| c | | 15⅛ | 15⅛ | 15⅛ | 15⅛ | 15⅛ | 15⅛ |
| g | | 5½ | 5½ | 5½ | 7½ | 7½ | 7½ |
| AXES X-X | I | 1117.1 | 1208.1 | 1318.8 | 1514.1 | 1648.4 | 1783.4 |
| | S | 124.12 | 133.42 | 144.59 | 168.23 | 181.94 | 195.57 |
| | r | 7.53 | 7.55 | 7.58 | 7.74 | 7.76 | 7.79 |
| AXES Y-Y | I | 76.4 | 82.9 | 90.9 | 214.7 | 234.0 | 253.4 |
| | S | 18.0 | 19.4 | 21.2 | 35.8 | 38.9 | 42.0 |
| | r | 1.97 | 1.98 | 1.99 | 2.91 | 2.93 | 2.94 |
| Coef. Str. | | 1489500 | 1601000 | 1735100 | 2018800 | 2183300 | 2346800 |
| Max. Mom.″# | | 2234200 | 2401500 | 2602600 | 3028200 | 3275000 | 3520200 |
| V | | 87700 | 94800 | 103100 | 92700 | 100700 | 109000 |
| P. feet | | 8 49 | 8.45 | 8.41 | 10 89 | 10.84 | 10 77 |
| R | | 44040 | 48930 | 54670 | 47760 | 53310 | 59040 |
| W | | 91350 | 98100 | 105980 | 96530 | 104180 | 112050 |
| Q. feet | | 8.15 | 8.16 | 8.18 | 10 46 | 10.48 | 10 47 |
| w lbs | | 41 | 41 | 41 | 41 | 41 | 41 |
| Rivet dia | | ⅞ | ⅞ | ⅞ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

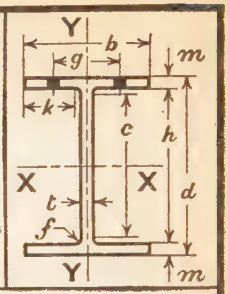
| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 175 | 175 | 190 | 190 | 206 | 206 | 185 | 185 | 201 | 201 | 218 | 218 | |
| 7 | 175 | 175 | 190 | 190 | 206 | 206 | 185 | 185 | 201 | 201 | 218 | 218 | |
| 8 | 175 | 175 | 190 | 190 | 206 | 206 | 185 | 185 | 201 | 201 | 218 | 218 | |
| 9 | 165 | 165 | 178 | 178 | 193 | 193 | 185 | 185 | 201 | 201 | 218 | 218 | |
| 10 | 149 | 149 | 160 | 160 | 174 | 174 | 185 | 185 | 201 | 201 | 218 | 218 | |
| 11 | 135 | 134 | 146 | 144 | 158 | 156 | 184 | 184 | 198 | 198 | 213 | 213 | .125 |
| 12 | 124 | 120 | 133 | 130 | 145 | 141 | 168 | 168 | 182 | 182 | 196 | 196 | .149 |
| 13 | 115 | 109 | 123 | 117 | 133 | 127 | 155 | 155 | 168 | 168 | 181 | 181 | .175 |
| 14 | 106 | 99 | 114 | 106 | 124 | 116 | 144 | 144 | 156 | 156 | 168 | 168 | .203 |
| 15 | 99 | 90 | 107 | 97 | 116 | 105 | 135 | 135 | 146 | 146 | 156 | 156 | .233 |
| 16 | 93 | 83 | 100 | 89 | 108 | 96 | 126 | 124 | 136 | 134 | 147 | 144 | .265 |
| 17 | 88 | 76 | 94 | 81 | 102 | 88 | 119 | 115 | 128 | 125 | 138 | 134 | .299 |
| 18 | 83 | 69 | 89 | 75 | 96 | 81 | 112 | 107 | 121 | 116 | 130 | 125 | .335 |
| 19 | 78 | 64 | 84 | 69 | 91 | 75 | 106 | 100 | 115 | 108 | 124 | 116 | .373 |
| 20 | 74 | 59 | 80 | 64 | 87 | 69 | 101 | 93 | 109 | 101 | 117 | 109 | .414 |
| 21 | 71 | 55 | 76 | 59 | 83 | 64 | 96 | 88 | 104 | 95 | 112 | 102 | .456 |
| 22 | 68 | 51 | 73 | 55 | 79 | 60 | 92 | 82 | 99 | 89 | 107 | 96 | .501 |
| 23 | 65 | 47 | 70 | 51 | 75 | 55 | 88 | 77 | 95 | 83 | 102 | 90 | .548 |
| 24 | 62 | 44 | 67 | 47 | 72 | 51 | 84 | 73 | 91 | 78 | 98 | 85 | .596 |
| 25 | 60 | 41 | 64 | 44 | 69 | 48 | 81 | 68 | 87 | 74 | 94 | 80 | .647 |
| 26 | 57 | 38 | 62 | 41 | 67 | 45 | 78 | 64 | 84 | 70 | 90 | 75 | .699 |
| 27 | 55 | 36 | 59 | 38 | 64 | 42 | 75 | 61 | 81 | 66 | 87 | 71 | .754 |
| 28 | 53 | 33 | 57 | 36 | 62 | 39 | 72 | 58 | 78 | 62 | 84 | 67 | .811 |
| 29 | 51 | ... | 55 | ... | 60 | ... | 70 | 54 | 75 | 59 | 81 | 64 | .870 |
| 30 | 50 | ... | 53 | ... | 58 | ... | 67 | 52 | 73 | 56 | 78 | 60 | .931 |
| 31 | 48 | ... | 52 | ... | 56 | ... | 65 | 49 | 70 | 53 | 76 | 57 | .994 |
| 32 | 47 | ... | 50 | ... | 54 | ... | 63 | 46 | 68 | 50 | 73 | 54 | 1.06 |
| 33 | 45 | ... | 49 | ... | 53 | ... | 61 | ... | 66 | ... | 71 | ... | 1.13 |
| 34 | 44 | ... | 47 | ... | 51 | ... | 59 | ... | 64 | ... | 69 | ... | 1.20 |
| 35 | 43 | ... | 46 | ... | 50 | ... | 58 | ... | 62 | ... | 67 | ... | 1.27 |
| 36 | 41 | ... | 44 | ... | 48 | ... | 56 | ... | 61 | ... | 65 | ... | 1.34 |

# 21" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details, see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



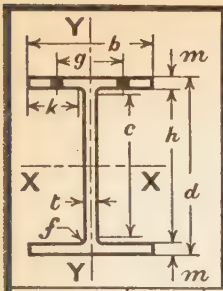

| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d". | | 20.890 | 21.000 | 21.126 | 21.248 | 21.370 |
| Wt. per foot. | | 55.0 | 58.0 | 64.0 | 70.0 | 76.0 |
| Area | | 16.17 | 17.05 | 18.82 | 20.59 | 22.34 |
| b" | | 8.000 | 8.000 | 8.036 | 8.073 | 8.109 |
| t | | .360 | .360 | .396 | .433 | .469 |
| h | | 19¾ | 19¾ | 19¾ | 19¾ | 19¾ |
| m | | .553 | .608 | .671 | .732 | .793 |
| k | | 3¼ | 3¼ | 3¼ | 3¼ | 3¼ |
| f | | .55 | .55 | .55 | .55 | .55 |
| c | | 18⅝ | 18⅝ | 18⅝ | 18⅝ | 18⅝ |
| g | | 4" | 4" | 4" | 4" | 4" |
| AXES X-X | I | 1166.7 | 1263.2 | 1403.3 | 1542.9 | 1684.0 |
| | S | 111.70 | 120.30 | 132.85 | 145.23 | 157.60 |
| | r | 8.49 | 8.61 | 8.64 | 8.66 | 8.68 |
| AXES Y-Y | I | 47.29 | 52.0 | 58.2 | 64.3 | 70.67 |
| | S | 11.8 | 13.0 | 14.5 | 15.9 | 17.4 |
| | r | 1.71 | 1.75 | 1.76 | 1.77 | 1.78 |
| Coef. Str | | 1340400 | 1443600 | 1594200 | 1742700 | 1891200 |
| Max.Mom."# | | 2010600 | 2165500 | 2391300 | 2614100 | 2836900 |
| V | | 90240 | 90700 | 100400 | 110400 | 120300 |
| P. feet | | 7.43 | 7.96 | 7.94 | 7.89 | 7.86 |
| R | | 36210 | 36180 | 42460 | 49010 | 55460 |
| W | | 48600 | 48600 | 53460 | 58460 | 63320 |
| Q. feet | | 13.79 | 14.85 | 14.91 | 14.91 | 14.93 |
| w. lbs | | 30 | 30 | 30 | 30 | 30 |
| Rivet dia | | ⅞ | ⅞ | ⅞ | ⅞ | ⅞ |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| feet | | | | | | | | | | | |
| 7 | 180 | 180 | 181 | 181 | 201 | 201 | 221 | 221 | 241 | 241 | |
| 8 | 168 | 168 | 180 | 180 | 199 | 199 | 218 | 218 | 236 | 236 | .057 |
| 9 | 149 | 149 | 160 | 160 | 177 | 177 | 194 | 194 | 210 | 210 | .072 |
| 10 | 134 | 134 | 144 | 144 | 159 | 159 | 174 | 174 | 189 | 189 | .089 |
| 11 | 122 | 119 | 131 | 128 | 145 | 142 | 158 | 156 | 172 | 169 | .107 |
| 12 | 112 | 107 | 120 | 115 | 133 | 127 | 145 | 139 | 158 | 151 | .123 |
| 13 | 103 | 96 | 111 | 104 | 123 | 115 | 134 | 126 | 145 | 136 | .150 |
| 14 | 96 | 87 | 103 | 94 | 114 | 104 | 124 | 114 | 135 | 124 | .174 |
| 15 | 89 | 79 | 96 | 85 | 106 | 94 | 116 | 103 | 126 | 112 | .200 |
| 16 | 84 | 72 | 90 | 78 | 100 | 86 | 109 | 94 | 118 | 102 | .227 |
| 17 | 79 | 66 | 85 | 71 | 94 | 79 | 103 | 86 | 111 | 94 | .257 |
| 18 | 74 | 61 | 80 | 65 | 89 | 72 | 97 | 79 | 105 | 86 | .287 |
| 19 | 71 | 56 | 76 | 60 | 84 | 67 | 92 | 73 | 100 | 79 | .320 |
| 20 | 67 | 51 | 72 | 55 | 80 | 61 | 87 | 67 | 95 | 73 | .355 |
| 21 | 64 | 47 | 69 | 51 | 76 | 57 | 83 | 62 | 90 | 68 | .391 |
| 22 | 61 | 44 | 66 | 47 | 72 | 52 | 79 | 57 | 86 | 63 | .429 |
| 23 | 58 | 41 | 63 | 44 | 69 | 49 | 76 | 53 | 82 | 58 | .470 |
| 24 | 56 | 38 | 60 | 41 | 66 | 45 | 73 | 49 | 79 | 54 | .511 |
| 25 | 54 | 35 | 58 | 38 | 64 | 42 | 70 | 46 | 76 | 50 | .554 |
| 26 | 52 | 33 | 56 | 35 | 61 | 39 | 67 | 43 | 73 | 46 | .600 |
| 27 | 50 | .. | 53 | .. | 59 | .. | 65 | .. | 70 | .. | .646 |
| 28 | 48 | .. | 52 | .. | 57 | .. | 62 | .. | 68 | .. | .695 |
| 29 | 46 | .. | 50 | .. | 55 | .. | 60 | .. | 65 | .. | .746 |
| 30 | 45 | .. | 48 | .. | 53 | .. | 58 | .. | 63 | .. | .798 |
| 32 | 42 | .. | 45 | .. | 50 | .. | 54 | .. | 59 | .. | .908 |
| 34 | 39 | .. | 42 | .. | 47 | .. | 51 | .. | 56 | .. | 1.03 |
| 36 | 37 | .. | 40 | .. | 44 | .. | 48 | .. | 53 | .. | 1.15 |
| 38 | 35 | .. | 38 | .. | 42 | .. | 46 | .. | 50 | .. | 1.28 |
| 40 | 33 | .. | 36 | .. | 40 | .. | 44 | .. | 47 | .. | 1.42 |
| 42 | 32 | .. | 34 | .. | 38 | .. | 41 | .. | 45 | .. | 1.56 |




# CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE LOADS

I is Moment of Inertia  S is Section Modulus

r is Radius of Gyration

V is Maximum Web Shear in Pounds.

P is Minimum Span in feet, uniformly loaded to cause V.

R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.

W is Maximum Load on one Standard Connection.

Q is Minimum Span in feet, uniformly loaded to cause W.

w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.

Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 21″ C

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | 21.000 | 21.120 | 21.240 | 21.358 | 21.000 | 21.126 | 21 248 | 21.372 | 21.492 | |
| Wt. per foot. | 80.0 | 86.0 | 92 0 | 98.0 | 104.0 | 112.0 | 120.0 | 128.0 | 136 0 | |
| Area. | 23.53 | 25.28 | 27.05 | 28.82 | 30.57 | 32.93 | 35.28 | 37.65 | 40 00 | |
| b″ | 9.000 | 9.032 | 9.064 | 9.097 | 13.000 | 13.034 | 13.070 | 13.105 | 13.141 | |
| t | .438 | .470 | .502 | .535 | .465 | .499 | .535 | .570 | .606 | |
| h | 19⅝16 | 19⅝16 | 19⅝16 | 19⅝16 | 19⅝16 | 19⅝16 | 19⅝16 | 19⅝16 | 19⅝16 | |
| m | .815 | .875 | .935 | .994 | .815 | .878 | .939 | 1.001 | 1.061 | |
| k | 3½ | 3½ | 3½ | 3½ | 5½ | 5½ | 5½ | 5½ | 5½ | |
| f | .75 | .75 | .75 | .75 | .75 | .75 | .75 | .75 | .75 | |
| c | 17⅞ | 17⅞ | 17⅞ | 17⅞ | 17⅞ | 17⅞ | 17⅞ | 17⅞ | 17⅞ | |
| g | 5½ | 5½ | 5½ | 5½ | 7½ | 7½ | 7½ | 7½ | 7½ | |
| AXES X-X I | 1794.4 | 1939.3 | 2086.4 | 2234.5 | 2475.3 | 2683.7 | 2890.9 | 3103.4 | 3313.7 | |
| AXES X-X S | 170.90 | 183.65 | 196.46 | 209.24 | 235.74 | 254.07 | 272.11 | 290.42 | 308.37 | |
| AXES X-X r | 8.73 | 8.76 | 8.78 | 8.80 | 9.00 | 9.03 | 9.05 | 9.08 | 9.10 | |
| AXES Y-Y I | 99.2 | 107.7 | 116.3 | 125.0 | 298.7 | 324.3 | 349.7 | 375.9 | 401.7 | |
| AXES Y-Y S | 22.0 | 23.8 | 25.7 | 27.5 | 45.9 | 49.8 | 53.5 | 57.4 | 61.1 | |
| AXES Y-Y r | 2.05 | 2.06 | 2.07 | 2.08 | 3.13 | 3.14 | 3 15 | 3.16 | 3.17 | |
| Coef. Str. | 2050700 | 2203700 | 2357500 | 2510900 | 2828900 | 3048800 | 3265300 | 3485000 | 3700400 | |
| Max.Mom.″# | 3076100 | 3305600 | 3536300 | 3766400 | 4243400 | 4573200 | 4898000 | 5227500 | 5550600 | |
| V | 110400 | 119100 | 128000 | 137100 | 117200 | 126500 | 136400 | 146200 | 156300 | |
| P. feet | 9.29 | 9 25 | 9.21 | 9 16 | 12.07 | 12 05 | 11.97 | 11.92 | 11.84 | |
| R | 49880 | 55580 | 61320 | 67260 | 54660 | 60730 | 67190 | 73500 | 80020 | |
| W | 59130 | 63450 | 67770 | 71580 | 104630 | 112280 | 119300 | 119300 | 119300 | |
| Q. feet | 17.34 | 17.37 | 17.39 | 17.54 | 13.52 | 13 58 | 13 69 | 14 61 | 15.51 | |
| w. lbs. | 30 | 30 | 30 | 30 | 41 | 41 | 41 | 41 | 41 | |
| Rivet dia | ⅞ | ⅞ | ⅞ | ⅞ | 1″ | 1″ | 1″ | 1″ | 1″ | |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 221 | 221 | 238 | 238 | 256 | 256 | 274 | 274 | 234 | 234 | 253 | 253 | 273 | 273 | 292 | 292 | 313 | 313 | |
| 8 | 221 | 221 | 238 | 238 | 256 | 256 | 274 | 274 | 234 | 234 | 253 | 253 | 273 | 273 | 292 | 292 | 313 | 313 | |
| 9 | 221 | 221 | 238 | 238 | 256 | 256 | 274 | 274 | 234 | 234 | 253 | 253 | 273 | 273 | 292 | 292 | 313 | 313 | |
| 10 | 205 | 205 | 220 | 220 | 236 | 236 | 251 | 251 | 234 | 234 | 253 | 253 | 273 | 273 | 292 | 292 | 313 | 313 | |
| 11 | 186 | 186 | 200 | 200 | 214 | 214 | 228 | 228 | 234 | 234 | 253 | 253 | 273 | 273 | 292 | 292 | 313 | 313 | |
| 12 | 171 | 168 | 184 | 181 | 196 | 194 | 209 | 207 | 234 | 234 | 253 | 253 | 272 | 272 | 290 | 290 | 308 | 308 | |
| 13 | 158 | 153 | 170 | 164 | 181 | 175 | 193 | 187 | 218 | 218 | 235 | 235 | 251 | 251 | 268 | 268 | 285 | 285 | .150 |
| 14 | 146 | 138 | 157 | 149 | 168 | 160 | 179 | 170 | 202 | 202 | 218 | 218 | 233 | 233 | 249 | 249 | 264 | 264 | .174 |
| 15 | 137 | 127 | 147 | 136 | 157 | 146 | 167 | 156 | 189 | 189 | 203 | 203 | 218 | 218 | 232 | 232 | 247 | 247 | .200 |
| 16 | 128 | 116 | 138 | 125 | 147 | 134 | 157 | 143 | 177 | 177 | 191 | 191 | 204 | 204 | 218 | 218 | 231 | 231 | .227 |
| 17 | 121 | 106 | 130 | 115 | 139 | 123 | 148 | 131 | 166 | 164 | 179 | 178 | 192 | 191 | 205 | 205 | 218 | 216 | .257 |
| 18 | 114 | 98 | 122 | 106 | 131 | 114 | 139 | 121 | 157 | 154 | 169 | 166 | 181 | 177 | 194 | 189 | 206 | 201 | .287 |
| 19 | 108 | 91 | 116 | 98 | 124 | 105 | 132 | 112 | 149 | 143 | 160 | 155 | 172 | 166 | 183 | 177 | 195 | 188 | .320 |
| 20 | 103 | 84 | 110 | 91 | 118 | 97 | 126 | 103 | 141 | 134 | 152 | 145 | 163 | 156 | 174 | 166 | 185 | 176 | .355 |
| 21 | 98 | 78 | 105 | 84 | 112 | 90 | 120 | 96 | 135 | 126 | 145 | 136 | 155 | 146 | 166 | 156 | 176 | 165 | .391 |
| 22 | 93 | 73 | 100 | 78 | 107 | 83 | 114 | 89 | 129 | 119 | 139 | 128 | 148 | 137 | 158 | 146 | 168 | 156 | .429 |
| 23 | 89 | 67 | 96 | 73 | 103 | 78 | 109 | 83 | 123 | 111 | 133 | 120 | 142 | 129 | 152 | 138 | 161 | 146 | .470 |
| 24 | 85 | 63 | 92 | 67 | 98 | 73 | 105 | 77 | 118 | 105 | 127 | 114 | 136 | 122 | 145 | 130 | 154 | 138 | .511 |
| 25 | 82 | 59 | 88 | 63 | 94 | 68 | 100 | 72 | 113 | 99 | 122 | 107 | 131 | 115 | 139 | 122 | 148 | 131 | .554 |
| 26 | 79 | 55 | 85 | 59 | 91 | 63 | 97 | 68 | 109 | 94 | 117 | 101 | 126 | 109 | 134 | 116 | 142 | 123 | .600 |
| 27 | 76 | 51 | 82 | 55 | 87 | 59 | 93 | 63 | 105 | 89 | 113 | 96 | 121 | 103 | 129 | 110 | 137 | 117 | .646 |
| 28 | 73 | 48 | 79 | 52 | 84 | 56 | 90 | 59 | 101 | 84 | 109 | 91 | 117 | 97 | 124 | 104 | 132 | 111 | .695 |
| 29 | 71 | 45 | 76 | 48 | 81 | 52 | 87 | 56 | 98 | 80 | 105 | 86 | 113 | 92 | 120 | 99 | 128 | 105 | .746 |
| 30 | 68 | 42 | 73 | 46 | 79 | 49 | 84 | 52 | 94 | 76 | 102 | 82 | 109 | 88 | 116 | 94 | 123 | 99 | .798 |
| 32 | 64 | .. | 69 | .. | 74 | .. | 78 | .. | 88 | 68 | 95 | 74 | 102 | 79 | 109 | 85 | 116 | 90 | .908 |
| 34 | 60 | .. | 65 | .. | 69 | .. | 74 | .. | 83 | 62 | 90 | 67 | 96 | 72 | 102 | 77 | 109 | 82 | 1.03 |
| 36 | 57 | .. | 61 | .. | 65 | .. | 70 | .. | 79 | 56 | 85 | 61 | 91 | 65 | 97 | 70 | 103 | 74 | 1.15 |
| 38 | 54 | .. | 58 | .. | 62 | .. | 66 | .. | 74 | .. | 80 | .. | 86 | 59 | 92 | 64 | 97 | 67 | 1.28 |
| 40 | 51 | .. | 55 | .. | 59 | .. | 63 | .. | 71 | .. | 76 | .. | 82 | .. | 87 | .. | 93 | .. | 1.42 |
| 42 | 49 | .. | 52 | .. | 56 | .. | 60 | .. | 67 | .. | 73 | .. | 78 | .. | 83 | .. | 88 | .. | 1.56 |

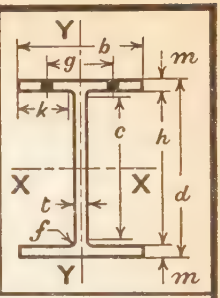
# 24" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



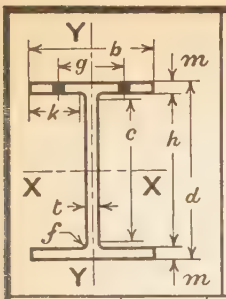

| | | | | | |
|---|---|---|---|---|---|
| Depth = d". | | 24 000 | 24 000 | 24.154 | 24.308 |
| Wt. per foot. | | 70.0 | 76 0 | 85.0 | 94 0 |
| Area..... | | 20.58 | 22 35 | 24 99 | 27 64 |
| b"..... | | 8.500 | 9.750 | 9.797 | 9.844 |
| t..... | | .400 | .405 | .452 | .499 |
| h..... | | 22⅝ | 22⅝ | 22⅝ | 22⅝ |
| m..... | | .663 | .663 | .740 | .817 |
| k..... | | 3 7/16 | 4 1/16 | 4 1/16 | 4 1/16 |
| f..... | | .60 | .60 | .60 | .60 |
| c..... | | 21⅜ | 21⅜ | 21⅜ | 21⅜ |
| g..... | | 4" | 5½ | 5½ | 5½ |
| AXES X-X | I.... | 1953.8 | 2184.4 | 2457.2 | 2734.9 |
| | S.... | 162.82 | 182.03 | 203.46 | 225.02 |
| | r.... | 9.74 | 9.89 | 9.92 | 9.95 |
| AXES Y-Y | I.... | 68.0 | 102.6 | 116.2 | 130.2 |
| | S.... | 16.0 | 21.0 | 23.7 | 26.4 |
| | r.... | 1.82 | 2.14 | 2.16 | 2.17 |
| Coef. Str.... | | 1953800 | 2184400 | 2441500 | 2700200 |
| Max.Mom."# | | 2930700 | 3276600 | 3662300 | 4050400 |
| V..... | | 115200 | 116600 | 131000 | 145600 |
| P. feet.. | | 8 48 | 9 36 | 9 32 | 9 27 |
| R..... | | 42750 | 43680 | 52580 | 61640 |
| W..... | | 54000 | 54680 | 61020 | 67370 |
| Q. feet.. | | 18.09 | 19 97 | 20 00 | 20.04 |
| w lbs... | | 30 | 30 | 30 | 30 |
| Rivet dia.... | | ⅞ | ⅞ | ⅞ | ⅞ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 230 | 230 | 233 | 233 | 262 | 262 | 291 | 291 | |
| 10 | 195 | 195 | 218 | 218 | 244 | 244 | 270 | 270 | .078 |
| 12 | 163 | 158 | 182 | 182 | 203 | 203 | 225 | 225 | .112 |
| 14 | 140 | 130 | 156 | 151 | 174 | 169 | 193 | 187 | .152 |
| 16 | 122 | 108 | 137 | 127 | 153 | 142 | 169 | 158 | .199 |
| 18 | 109 | 91 | 121 | 108 | 136 | 121 | 150 | 134 | .251 |
| 20 | 98 | 78 | 109 | 93 | 122 | 104 | 135 | 115 | .310 |
| 21 | 93 | 72 | 104 | 87 | 116 | 97 | 129 | 108 | .342 |
| 22 | 89 | 67 | 99 | 81 | 111 | 90 | 123 | 100 | .375 |
| 23 | 85 | 62 | 95 | 75 | 106 | 84 | 117 | 94 | .411 |
| 24 | 81 | 57 | 91 | 70 | 102 | 79 | 113 | 88 | .447 |
| 25 | 78 | 54 | 87 | 66 | 98 | 74 | 108 | 82 | .485 |
| 26 | 75 | 50 | 84 | 62 | 94 | 69 | 104 | 77 | .525 |
| 27 | 72 | 47 | 81 | 58 | 90 | 65 | 100 | 72 | .566 |
| 28 | 70 | 44 | 78 | 54 | 87 | 61 | 96 | 68 | .608 |
| 29 | 67 | ... | 75 | 51 | 84 | 57 | 93 | 64 | .653 |
| 30 | 65 | ... | 73 | 48 | 81 | 54 | 90 | 60 | .698 |
| 31 | 63 | ... | 70 | 45 | 79 | 51 | 87 | 57 | .746 |
| 32 | 61 | ... | 68 | 43 | 76 | 48 | 84 | 53 | .795 |
| 33 | 59 | ... | 66 | ... | 74 | ... | 82 | ... | .845 |
| 34 | 57 | ... | 64 | ... | 72 | ... | 79 | ... | .897 |
| 35 | 56 | ... | 62 | ... | 70 | .. | 77 | ... | .950 |
| 36 | 54 | ... | 61 | .. | 68 | ... | 75 | ... | 1.01 |
| 38 | 51 | ... | 57 | ... | 64 | ... | 71 | ... | 1.12 |
| 40 | 49 | ... | 55 | ... | 61 | ... | 68 | ... | 1.24 |
| 42 | 47 | ... | 52 | ... | 58 | ... | 64 | ... | 1.37 |
| 44 | 44 | ... | 50 | ... | 55 | ... | 61 | ... | 1.50 |
| 46 | 42 | ... | 47 | ... | 53 | ... | 59 | ... | 1.64 |
| 48 | 41 | ... | 46 | ... | 51 | ... | 56 | ... | 1.79 |
| 50 | 39 | ... | 44 | ... | 49 | ... | 54 | ... | 1.94 |




# CARNEGIE BEAMS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 24″ C

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth = d″ | | 24 000 | 24 156 | 24 310 | 24 250 | 24 388 | 24 526 | 24 664 |
| Wt. per foot | | 100 0 | 110 0 | 120 0 | 130 0 | 140 0 | 150 0 | 160 0 |
| Area | | 29 41 | 32 34 | 35 29 | 38 23 | 41 16 | 44 10 | 47 06 |
| b″ | | 12 000 | 12 044 | 12 089 | 14 000 | 14 041 | 14 082 | 14 123 |
| t | | 450 | 494 | 539 | 547 | 588 | 629 | 670 |
| h | | 22⅜ | 22⅜ | 22⅜ | 22⅜ | 22⅜ | 22⅜ | 22⅜ |
| m | | 787 | 865 | 942 | 912 | 981 | 1 050 | 1 119 |
| k | | 5″ | 5″ | 5″ | 5 15/16″ | 5 15/16″ | 5 15/16″ | 5 15/16″ |
| f | | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| c | | 20¾ | 20¾ | 20¾ | 20¾ | 20¾ | 20¾ | 20¾ |
| g | | 7½ | 7½ | 7½ | 10″ | 10″ | 10″ | 10″ |
| AXES X-X | I | 3020 5 | 3343 5 | 3669 7 | 4045 1 | 4380 4 | 4720 5 | 5065 7 |
| | S | 251.71 | 276 83 | 301.91 | 333.62 | 359 23 | 384 94 | 410.78 |
| | r | 10 14 | 10 17 | 10 20 | 10 29 | 10 32 | 10 35 | 10 38 |
| AXES Y-Y | I | 226 9 | 252 2 | 277.8 | 417.5 | 453 1 | 489 3 | 526 0 |
| | S | 37 8 | 41 9 | 46.0 | 59.6 | 64.5 | 69.5 | 74 5 |
| | r | 2 78 | 2 79 | 2 81 | 3 31 | 3 32 | 3 33 | 3 34 |
| Coef. Str | | 3020500 | 3321900 | 3622900 | 4003400 | 4310700 | 4619300 | 4929300 |
| Max Mom.″# | | 4530700 | 4982900 | 5434300 | 6005100 | 6466100 | 6928900 | 7394000 |
| V | | 129600 | 143200 | 157200 | 159200 | 172100 | 185100 | 198300 |
| P. feet | | 11 65 | 11 60 | 11 52 | 12 57 | 12.52 | 12 47 | 12 43 |
| R | | 52200 | 60650 | 69400 | 70920 | 78940 | 87000 | 95100 |
| W | | 121500 | 133380 | 143160 | 143160 | 143160 | 143160 | 143160 |
| Q. feet | | 12 43 | 12 45 | 12 65 | 13 98 | 15.06 | 16.13 | 17 22 |
| w lbs. | | 49 | 49 | 49 | 49 | 49 | 49 | 49 |
| Rivet dia | | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 259 | 259 | 286 | 286 | 314 | 314 | 318 | 318 | 344 | 344 | 370 | 370 | 397 | 397 | |
| 10 | 259 | 259 | 286 | 286 | 314 | 314 | 318 | 318 | 344 | 344 | 370 | 370 | 397 | 397 | |
| 12 | 252 | 252 | 277 | 277 | 302 | 302 | 318 | 318 | 344 | 344 | 370 | 370 | 397 | 397 | |
| 14 | 216 | 216 | 237 | 237 | 259 | 259 | 286 | 286 | 308 | 308 | 330 | 330 | 352 | 352 | .152 |
| 16 | 189 | 186 | 208 | 205 | 226 | 223 | 250 | 250 | 269 | 269 | 289 | 289 | 308 | 308 | .199 |
| 18 | 168 | 160 | 185 | 176 | 201 | 193 | 222 | 221 | 239 | 238 | 257 | 255 | 274 | 273 | .251 |
| 20 | 151 | 140 | 166 | 154 | 181 | 168 | 200 | 194 | 216 | 209 | 231 | 224 | 246 | 239 | .310 |
| 21 | 144 | 131 | 158 | 144 | 173 | 158 | 191 | 182 | 205 | 196 | 220 | 210 | 235 | 225 | .342 |
| 22 | 137 | 123 | 151 | 135 | 165 | 148 | 182 | 172 | 196 | 185 | 210 | 198 | 224 | 212 | .375 |
| 23 | 131 | 115 | 144 | 127 | 158 | 139 | 174 | 162 | 187 | 174 | 201 | 188 | 214 | 200 | .411 |
| 24 | 126 | 109 | 138 | 119 | 151 | 131 | 167 | 153 | 180 | 165 | 192 | 177 | 205 | 189 | .447 |
| 25 | 121 | 102 | 133 | 112 | 145 | 123 | 160 | 145 | 172 | 156 | 185 | 167 | 197 | 179 | .485 |
| 26 | 116 | 96 | 128 | 106 | 139 | 116 | 154 | 137 | 166 | 148 | 178 | 158 | 190 | 170 | .525 |
| 27 | 112 | 91 | 123 | 100 | 134 | 110 | 148 | 130 | 160 | 140 | 171 | 150 | 183 | 160 | .566 |
| 28 | 108 | 86 | 119 | 95 | 129 | 104 | 143 | 123 | 154 | 133 | 165 | 143 | 176 | 153 | .608 |
| 29 | 104 | 81 | 115 | 90 | 125 | 98 | 138 | 117 | 149 | 126 | 159 | 135 | 170 | 145 | 653 |
| 30 | 101 | 77 | 111 | 85 | 121 | 93 | 133 | 111 | 144 | 121 | 154 | 129 | 164 | 138 | 698 |
| 31 | 97 | 73 | 107 | 80 | 117 | 88 | 129 | 106 | 139 | 114 | 149 | 123 | 159 | 131 | .746 |
| 32 | 94 | 69 | 104 | 75 | 113 | 84 | 125 | 101 | 135 | 109 | 144 | 117 | 154 | 125 | .795 |
| 33 | 92 | 66 | 101 | 71 | 110 | 79 | 121 | 96 | 131 | 104 | 140 | 112 | 149 | 119 | 845 |
| 34 | 89 | 63 | 98 | 68 | 107 | 75 | 118 | 92 | 127 | 99 | 136 | 106 | 145 | 113 | .897 |
| 35 | 86 | 59 | 95 | 64 | 104 | 72 | 114 | 88 | 123 | 94 | 132 | 102 | 141 | 108 | .950 |
| 36 | 84 | 57 | 92 | 61 | 101 | 68 | 111 | 84 | 120 | 90 | 128 | 97 | 137 | 104 | 1 01 |
| 38 | 79 | 51 | 87 | 55 | 95 | 62 | 105 | 77 | 113 | 82 | 122 | 88 | 130 | 95 | 1.12 |
| 40 | 76 | 47 | 83 | ... | 91 | 56 | 100 | 70 | 108 | 75 | 115 | 80 | 123 | 87 | 1 24 |
| 42 | 72 | ... | 79 | ... | 86 | ... | 95 | 64 | 103 | 69 | 110 | 75 | 117 | 80 | 1 37 |
| 44 | 69 | ... | 75 | ... | 82 | ... | 91 | ... | 98 | ... | 105 | .. | 112 | 73 | 1 50 |
| 46 | 66 | ... | 72 | ... | 79 | ... | 87 | ... | 94 | ... | 100 | ... | 107 | ... | 1 64 |
| 48 | 63 | ... | 69 | ... | 75 | ... | 83 | ... | 90 | .. | 96 | ... | 103 | ... | 1 79 |
| 50 | 60 | ... | 66 | ... | 72 | ... | 80 | .. | 86 | ... | 92 | ... | 99 | ... | 1 94 |

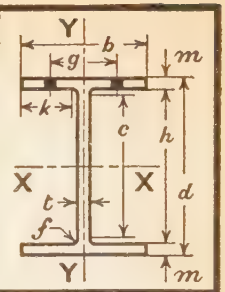
# 27″ C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



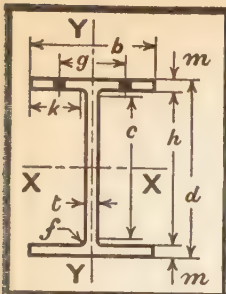

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth = d″. | 26.820 | 27.000 | 27.166 | 27 340 | 27.536 | 27.742 | |
| Wt. per foot. | 85.0 | 91.0 | 101.0 | 112.0 | 124.0 | 137.0 | |
| Area | 25.00 | 26.76 | 29.70 | 32.94 | 36.47 | 40.29 | |
| b″ | 9.750 | 9.750 | 9.799 | 9.855 | 9.913 | 9.977 | |
| t | .461 | .461 | .510 | .566 | .624 | .688 | |
| h | 25 7/16 | 25 7/16 | 25 7/16 | 25 7/16 | 25 7/16 | 25 7/16 | |
| m | .665 | .755 | .838 | .925 | 1 023 | 1.126 | |
| k | 4″ | 4″ | 4″ | 4″ | 4″ | 4″ | |
| f | .65 | .65 | .65 | .65 | .65 | .65 | |
| c | 24 1/8 | 24 1/8 | 24 1/8 | 24 1/8 | 24 1/8 | 24 1/8 | |
| g | 5½ | 5½ | 5½ | 5½ | 5½ | 5½ | |
| AXES X-X I | 2899.3 | 3217.0 | 3595.7 | 4007.6 | 4472.1 | 4975.9 | |
| AXES X-X S | 216.20 | 238.30 | 264.72 | 293 17 | 324.82 | 358.73 | |
| AXES X-X r | 10.77 | 10.97 | 11.00 | 11.03 | 11.07 | 11.11 | |
| AXES Y-Y I | 103.0 | 116.9 | 131.7 | 148.0 | 166.7 | 187.1 | |
| AXES Y-Y S | 21.1 | 24.0 | 26.9 | 30.0 | 33.6 | 37.5 | |
| AXES Y-Y r | 2.03 | 2.09 | 2.11 | 2.12 | 2.14 | 2.16 | |
| Coef. Str | 2594500 | 2859500 | 3176600 | 3518000 | 3897800 | 4304700 | |
| Max. Mom. "M" | 3891700 | 4289300 | 4765000 | 5277000 | 5846700 | 6457100 | |
| V | 148400 | 149400 | 166300 | 185700 | 206200 | 229000 | |
| P. feet | 8.74 | 9.57 | 9.55 | 9.47 | 9.45 | 9.40 | |
| R | 54140 | 54120 | 64140 | 75810 | 88050 | 101660 | |
| W | 82980 | 82980 | 91800 | 95440 | 95440 | 95440 | |
| Q. feet | 15.63 | 17.23 | 17.30 | 18.43 | 20.42 | 22.55 | |
| w lbs | 40 | 40 | 40 | 40 | 40 | 40 | |
| Rivet dia | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | |

Live Load deflection must not exceed 1/360 of the Span.

$$\text{Live Load Def.} = \frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 297 | 297 | 299 | 299 | 333 | 333 | 371 | 371 | 412 | 412 | 458 | 458 | |
| 10 | 259 | 259 | 286 | 286 | 318 | 318 | 352 | 352 | 390 | 390 | 423 | 423 | |
| 12 | 216 | 216 | 238 | 238 | 265 | 265 | 293 | 293 | 325 | 325 | 352 | 352 | |
| 14 | 185 | 179 | 204 | 198 | 227 | 219 | 251 | 244 | 278 | 270 | 302 | 294 | .135 |
| 16 | 162 | 151 | 179 | 166 | 199 | 185 | 220 | 206 | 244 | 228 | 264 | 248 | .177 |
| 18 | 144 | 128 | 159 | 141 | 176 | 158 | 195 | 175 | 217 | 197 | 235 | 211 | .223 |
| 20 | 130 | 111 | 143 | 122 | 159 | 136 | 176 | 151 | 195 | 167 | 211 | 182 | .276 |
| 21 | 124 | 103 | 136 | 114 | 151 | 126 | 168 | 140 | 186 | 156 | 201 | 170 | .304 |
| 22 | 118 | 96 | 130 | 106 | 144 | 118 | 160 | 131 | 177 | 145 | 192 | 158 | .334 |
| 23 | 113 | 90 | 124 | 99 | 138 | 110 | 153 | 122 | 169 | 136 | 184 | 147 | .365 |
| 24 | 108 | 84 | 119 | 92 | 132 | 102 | 147 | 114 | 162 | 127 | 176 | 138 | .397 |
| 25 | 104 | 78 | 114 | 86 | 127 | 96 | 141 | 107 | 156 | 119 | 169 | 130 | .431 |
| 26 | 100 | 73 | 110 | 81 | 122 | 90 | 135 | 100 | 150 | 111 | 163 | 121 | .466 |
| 27 | 96 | 69 | 106 | 76 | 118 | 85 | 130 | 94 | 144 | 104 | 157 | 114 | .503 |
| 28 | 93 | 65 | 102 | 71 | 113 | 79 | 126 | 88 | 139 | 98 | 151 | 107 | .540 |
| 29 | 89 | 61 | 99 | 67 | 110 | 75 | 121 | 83 | 134 | 93 | 146 | 100 | .580 |
| 30 | 86 | 57 | 95 | 63 | 106 | 70 | 117 | 78 | 130 | 87 | 141 | 95 | .621 |
| 31 | 84 | 54 | 92 | 59 | 102 | 66 | 113 | 74 | 126 | 82 | 136 | 89 | .662 |
| 32 | 81 | ... | 89 | 56 | 99 | 62 | 110 | 69 | 122 | 77 | 132 | 84 | .706 |
| 33 | 79 | ... | 87 | ... | 96 | ... | 107 | ... | 118 | 73 | 128 | 79 | .751 |
| 34 | 76 | ... | 84 | ... | 93 | ... | 103 | ... | 115 | ... | 124 | ... | .797 |
| 35 | 74 | ... | 82 | ... | 91 | ... | 101 | ... | 111 | ... | 121 | ... | .844 |
| 36 | 72 | ... | 79 | ... | 88 | ... | 98 | ... | 108 | ... | 117 | ... | .894 |
| 38 | 68 | ... | 75 | ... | 84 | ... | 93 | ... | 103 | ... | 111 | ... | .996 |
| 40 | 65 | ... | 71 | ... | 79 | ... | 88 | ... | 97 | ... | 106 | ... | 1.10 |
| 42 | 62 | ... | 68 | ... | 76 | ... | 84 | ... | 93 | ... | 101 | ... | 1.22 |
| 44 | 59 | ... | 65 | ... | 72 | ... | 80 | ... | 89 | ... | 96 | ... | 1.34 |
| 46 | 56 | ... | 62 | ... | 69 | ... | 76 | ... | 85 | ... | 92 | ... | 1.46 |
| 48 | 54 | ... | 60 | ... | 66 | ... | 73 | ... | 81 | ... | 88 | ... | 1.59 |
| 50 | 52 | ... | 57 | ... | 64 | ... | 70 | ... | 78 | ... | 85 | ... | 1.72 |




# CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 27″ C

| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d″. | | 27.000 | 27.200 | 27.400 | 27.598 | Live Load deflection must not exceed 1/360 of the span. |
| Wt. per foot. | | 145.0 | 160.0 | 175.0 | 190.0 | |
| Area | | 42.64 | 47.04 | 51.47 | 55.87 | |
| b″ | | 14.000 | 14.059 | 14.118 | 14.176 | |
| t | | .580 | .639 | .698 | .756 | |
| h | | 25″ | 25″ | 25″ | 25″ | |
| m | | .985 | 1.085 | 1.185 | 1.284 | |
| k | | 5 13/16″ | 5 13/16″ | 5 13/16″ | 5 13/16″ | |
| f | | .90 | .90 | .90 | .90 | |
| c | | 23¼ | 23¼ | 23¼ | 23¼ | |
| g | | 10″ | 10″ | 10″ | 10″ | |
| AXES X-X | I | 5508.7 | 6121.8 | 6746.8 | 7376.9 | Live Load Def. = Total Def. × Live Load / Tabular Load |
| | S | 408.05 | 450.13 | 492.47 | 534.60 | |
| | r | 11.37 | 11.41 | 11.45 | 11.49 | |
| AXES Y-Y | I | 451.0 | 503.2 | 556.6 | 610.7 | |
| | S | 64.4 | 71.6 | 78.9 | 86.2 | |
| | r | 3.25 | 3.27 | 3.29 | 3.31 | |
| Coef. Str. | | 4896600 | 5401600 | 5909600 | 6415200 | |
| Max. Mom.″# | | 7344900 | 8102400 | 8864400 | 9622700 | |
| V | | 187900 | 208600 | 229500 | 250400 | |
| P. feet | | 13.03 | 12.95 | 12.88 | 12.81 | |
| R | | 78620 | 90990 | 103470 | 115800 | |
| W | | 167020 | 167020 | 167020 | 167020 | |
| Q. feet | | 14.66 | 16.17 | 17.69 | 19.20 | |
| w lbs. | | 58 | 58 | 58 | 58 | |
| Rivet dia. | | 1″ | 1″ | 1″ | 1″ | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 376 | 376 | 417 | 417 | 459 | 459 | 501 | 501 | |
| 10 | 376 | 376 | 417 | 417 | 459 | 459 | 501 | 501 | |
| 12 | 376 | 376 | 417 | 417 | 459 | 459 | 501 | 501 | |
| 14 | 350 | 350 | 386 | 386 | 422 | 422 | 458 | 458 | .135 |
| 16 | 306 | 306 | 338 | 338 | 369 | 369 | 401 | 401 | .177 |
| 18 | 272 | 270 | 300 | 299 | 328 | 327 | 356 | 355 | .223 |
| 20 | 245 | 237 | 270 | 262 | 295 | 287 | 321 | 311 | .276 |
| 21 | 233 | 223 | 257 | 246 | 281 | 270 | 305 | 293 | .304 |
| 22 | 223 | 210 | 246 | 232 | 269 | 254 | 292 | 277 | .334 |
| 23 | 213 | 198 | 235 | 218 | 257 | 240 | 279 | 260 | .365 |
| 24 | 204 | 187 | 225 | 207 | 246 | 226 | 267 | 246 | .397 |
| 25 | 196 | 177 | 216 | 196 | 236 | 214 | 257 | 233 | .431 |
| 26 | 188 | 168 | 208 | 185 | 227 | 203 | 247 | 221 | .466 |
| 27 | 181 | 159 | 200 | 176 | 219 | 192 | 238 | 210 | .503 |
| 28 | 175 | 151 | 193 | 166 | 211 | 183 | 229 | 199 | .540 |
| 29 | 169 | 144 | 186 | 158 | 204 | 173 | 221 | 189 | .580 |
| 30 | 163 | 136 | 180 | 151 | 197 | 165 | 214 | 179 | .621 |
| 31 | 158 | 130 | 174 | 143 | 191 | 158 | 207 | 171 | .662 |
| 32 | 153 | 123 | 169 | 137 | 185 | 150 | 200 | 163 | .706 |
| 33 | 148 | 118 | 164 | 130 | 179 | 143 | 194 | 155 | .751 |
| 34 | 144 | 112 | 159 | 124 | 174 | 136 | 189 | 148 | .797 |
| 35 | 140 | 107 | 154 | 119 | 169 | 130 | 183 | 141 | .844 |
| 36 | 136 | 103 | 150 | 113 | 164 | 124 | 178 | 135 | .894 |
| 38 | 129 | 94 | 142 | 103 | 156 | 114 | 169 | 123 | .996 |
| 40 | 122 | 86 | 135 | 95 | 148 | 104 | 160 | 114 | 1.10 |
| 42 | 117 | 79 | 129 | 87 | 141 | 95 | 153 | 104 | 1.22 |
| 44 | 111 | 72 | 123 | 80 | 134 | 88 | 146 | 96 | 1.34 |
| 46 | 106 | 66 | 117 | 74 | 128 | 81 | 139 | 88 | 1.46 |
| 48 | 102 | ... | 113 | ... | 123 | ... | 134 | ... | 1.59 |
| 50 | 98 | ... | 108 | ... | 118 | ... | 128 | ... | 1.72 |

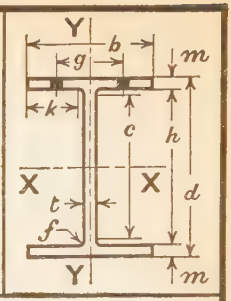
# 30" C

## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



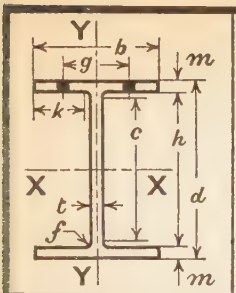

| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d". | | 30.000 | 30.162 | 30.344 | 30.538 | 30.742 |
| Wt. per foot. | | 115.0 | 126.0 | 138.0 | 151.0 | 165.0 |
| Area | | 33.81 | 37.05 | 40 58 | 44.41 | 48.52 |
| b" | | 10.500 | 10.551 | 10 604 | 10.662 | 10.725 |
| t | | .530 | .581 | .634 | .692 | .755 |
| h | | 28 3/16 | 28 3/16 | 28 3/16 | 28 3/16 | 28 3/16 |
| m | | .882 | .963 | 1.054 | 1.151 | 1 253 |
| k | | 4 5/16 | 4 5/16 | 4 5/16 | 4 5/16 | 4 5/16 |
| f | | .70 | .70 | .70 | .70 | .70 |
| c | | 26 3/4 | 26 3/4 | 26 3/4 | 26 3/4 | 26 3/4 |
| g | | 5 1/2 | 5 1/2 | 5 1/2 | 5 1/2 | 5 1/2 |
| AXES X-X | I | 4985.3 | 5486.7 | 6049.5 | 6663.7 | 7376 7 |
| | S | 332.35 | 363.82 | 398.73 | 436 42 | 476 66 |
| | r | 12 14 | 12.17 | 12.21 | 12 25 | 12 29 |
| AXES Y-Y | I | 170.6 | 189.0 | 210.1 | 233 4 | 258.7 |
| | S | 32.5 | 35.8 | 39.6 | 43 8 | 48 2 |
| | r | 2.25 | 2.26 | 2.28 | 2 29 | 2 31 |
| Coef. Str. | | 3988200 | 4365800 | 4784700 | 5237000 | 5719900 |
| Max. Mom."s | | 5982400 | 6548700 | 7177100 | 7855600 | 8579900 |
| V. | | 190800 | 210300 | 230900 | 253600 | 278500 |
| P. feet | | 10 45 | 10.38 | 10.36 | 10.33 | 10.27 |
| R. | | 68410 | 79670 | 91550 | 104700 | 119090 |
| W. | | 107330 | 107370 | 107370 | 107370 | 107370 |
| Q. feet | | 18 58 | 20 33 | 22.28 | 24.38 | 26 64 |
| w lbs | | 45 | 45 | 45 | 45 | 45 |
| Rivet dia | | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = (Total Def. × Live Load) / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load, Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 382 | 382 | 421 | 421 | 462 | 462 | 507 | 507 | 557 | 557 | |
| 12 | 332 | 332 | 364 | 364 | 399 | 399 | 436 | 436 | 477 | 477 | |
| 14 | 285 | 281 | 312 | 307 | 342 | 338 | 374 | 370 | 409 | 404 | .122 |
| 16 | 249 | 237 | 273 | 260 | 299 | 286 | 327 | 313 | 358 | 342 | .159 |
| 18 | 222 | 203 | 243 | 223 | 266 | 245 | 291 | 268 | 318 | 293 | .201 |
| 20 | 199 | 176 | 218 | 193 | 239 | 211 | 262 | 232 | 286 | 254 | .248 |
| 21 | 190 | 164 | 208 | 179 | 228 | 197 | 249 | 216 | 272 | 237 | .274 |
| 22 | 181 | 153 | 198 | 168 | 217 | 184 | 238 | 202 | 260 | 222 | .300 |
| 23 | 173 | 143 | 190 | 157 | 208 | 173 | 228 | 189 | 249 | 208 | .329 |
| 24 | 166 | 134 | 182 | 147 | 199 | 162 | 218 | 178 | 238 | 195 | .358 |
| 25 | 160 | 126 | 175 | 138 | 191 | 152 | 209 | 166 | 229 | 183 | .388 |
| 26 | 153 | 118 | 168 | 130 | 184 | 142 | 201 | 157 | 220 | 172 | .420 |
| 27 | 148 | 111 | 162 | 122 | 177 | 134 | 194 | 147 | 212 | 162 | .452 |
| 28 | 142 | 105 | 156 | 115 | 171 | 126 | 187 | 139 | 204 | 153 | .487 |
| 29 | 138 | 98 | 151 | 108 | 165 | 119 | 181 | 131 | 197 | 143 | .522 |
| 30 | 133 | 93 | 145 | 102 | 159 | 112 | 175 | 124 | 191 | 136 | .559 |
| 31 | 129 | 88 | 141 | 97 | 154 | 106 | 169 | 116 | 185 | 128 | .596 |
| 32 | 125 | 83 | 136 | 91 | 150 | 100 | 164 | 110 | 179 | 121 | .636 |
| 33 | 121 | 78 | 132 | 86 | 145 | 95 | 159 | 104 | 173 | 114 | .676 |
| 34 | 117 | 74 | 128 | 81 | 141 | 90 | 154 | 99 | 168 | 109 | .718 |
| 35 | 114 | 70 | 125 | 77 | 137 | 85 | 150 | 93 | 163 | 103 | .760 |
| 36 | 111 | ... | 121 | ... | 133 | ... | 145 | . | 159 | ... | .804 |
| 38 | 105 | ... | 115 | ... | 126 | . | 138 | ... | 151 | ... | .896 |
| 40 | 100 | ... | 109 | ... | 120 | ... | 131 | ... | 143 | ... | .993 |
| 42 | 95 | ... | 104 | ... | 114 | .. | 125 | ... | 136 | ... | 1.10 |
| 44 | 91 | ... | 99 | . . | 109 | .. | 119 | . . | 130 | ... | 1.20 |
| 46 | 87 | ... | 95 | . . | 104 | . . | 114 | . . | 124 | ... | 1.31 |
| 48 | 83 | ... | 91 | .. | 100 | ... | 109 | ... | 119 | ... | 1.43 |
| 50 | 80 | ... | 87 | . | 96 | . | 105 | ... | 114 | ... | 1.55 |
| 52 | 77 | ... | 84 | . . | 92 | | 101 | . | 110 | ... | 1.68 |




# CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 30″ C

| | | | | | |
|---|---|---|---|---|---|
| Depth = d″. | | 30.000 | 30.263 | 30.522 | 30 781 |
| Wt. per foot. | | 180.0 | 200.0 | 220.0 | 240 0 |
| Area | | 52.93 | 58.82 | 64.70 | 70 58 |
| b″ | | 14.000 | 14.073 | 14.146 | 14.218 |
| t | | .670 | .743 | .816 | 888 |
| h | | 27 9/16 | 27 9/16 | 27 9/16 | 27 9/16 |
| m | | 1.207 | 1.338 | 1.468 | 1 597 |
| k | | 5 11/16 | 5 11/16 | 5 11/16 | 5 11/16 |
| f | | 1.00 | 1.00 | 1.00 | 1 00 |
| c | | 25½ | 25½ | 25½ | 25½ |
| g | | 10″ | 10″ | 10″ | 10″ |
| AXES X-X | I | 8301.4 | 9305.7 | 10320.4 | 11356.0 |
| | S | 553.43 | 614.99 | 676.26 | 737.86 |
| | r | 12.52 | 12.58 | 12.63 | 12.69 |
| AXES Y-Y | I | 552.7 | 622.7 | 693.9 | 766.9 |
| | S | 79.0 | 88.5 | 98.1 | 107.9 |
| | r | 3.23 | 3.25 | 3.28 | 3.30 |
| Coef. Str. | | 6641100 | 7379900 | 8115100 | 8854300 |
| Max. Mom.″# | | 9961700 | 11069800 | 12172700 | 13281400 |
| V | | 241200 | 269800 | 298900 | 328000 |
| P. feet | | 13.77 | 13.68 | 13.58 | 13.50 |
| R | | 99440 | 115940 | 132570 | 149090 |
| W | | 190880 | 190880 | 190880 | 190880 |
| Q. feet | | 17.40 | 19.33 | 21.26 | 23.19 |
| w lbs | | 66 | 66 | 66 | 66 |
| Rivet dia | | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 482 | 482 | 540 | 540 | 598 | 598 | 656 | 656 | |
| 12 | 482 | 482 | 540 | 540 | 598 | 59o | 656 | 656 | |
| 14 | 474 | 474 | 527 | 527 | 580 | 580 | 632 | 632 | .122 |
| 16 | 415 | 415 | 461 | 461 | 507 | 507 | 553 | 553 | .159 |
| 18 | 369 | 366 | 410 | 408 | 451 | 449 | 492 | 490 | .201 |
| 20 | 332 | 321 | 369 | 358 | 406 | 394 | 443 | 430 | .248 |
| 21 | 316 | 302 | 351 | 336 | 386 | 371 | 422 | 405 | .274 |
| 22 | 302 | 285 | 335 | 317 | 369 | 349 | 402 | 382 | .300 |
| 23 | 289 | 268 | 321 | 300 | 353 | 329 | 385 | 359 | .329 |
| 24 | 277 | 254 | 307 | 282 | 338 | 312 | 369 | 340 | .358 |
| 25 | 266 | 240 | 295 | 268 | 325 | 294 | 354 | 322 | .388 |
| 26 | 255 | 227 | 284 | 253 | 312 | 279 | 341 | 305 | .420 |
| 27 | 246 | 215 | 273 | 240 | 301 | 264 | 328 | 289 | .452 |
| 28 | 237 | 205 | 264 | 227 | 290 | 251 | 316 | 274 | .487 |
| 29 | 229 | 195 | 254 | 216 | 280 | 239 | 305 | 261 | .522 |
| 30 | 221 | 185 | 246 | 206 | 271 | 227 | 295 | 249 | .559 |
| 31 | 214 | 176 | 238 | 196 | 262 | 216 | 286 | 236 | .596 |
| 32 | 208 | 167 | 231 | 187 | 254 | 205 | 277 | 225 | .636 |
| 33 | 201 | 160 | 224 | 178 | 246 | 196 | 268 | 215 | .676 |
| 34 | 195 | 152 | 217 | 170 | 239 | 188 | 260 | 205 | .718 |
| 35 | 190 | 145 | 211 | 162 | 232 | 179 | 253 | 196 | .760 |
| 36 | 184 | 139 | 205 | 155 | 225 | 171 | 246 | 187 | .804 |
| 38 | 175 | 127 | 194 | 141 | 214 | 156 | 233 | 171 | .896 |
| 40 | 166 | 116 | 184 | 130 | 203 | 143 | 221 | 157 | .993 |
| 42 | 158 | 107 | 176 | 119 | 193 | 131 | 211 | 144 | 1.10 |
| 44 | 151 | 98 | 168 | 109 | 184 | 121 | 201 | 132 | 1.20 |
| 46 | 144 | 90 | 160 | 101 | 176 | 111 | 192 | 122 | 1.31 |
| 48 | 138 | ... | 154 | ... | 169 | ... | 184 | ... | 1.43 |
| 50 | 133 | ... | 148 | ... | 162 | ... | 177 | ... | 1.55 |
| 52 | 128 | ... | 142 | ... | 156 | ... | 170 | ... | 1.68 |

# 33" C

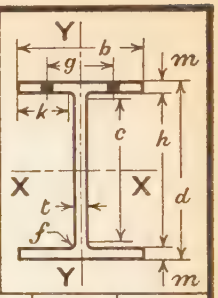
## CARNEGIE BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration

V is Maximum Web Shear in Pounds
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets.

Rivet given is Maximum diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



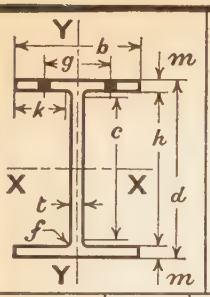

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d" | | 33.000 | 33.164 | 33 342 | 33.530 | 33.000 | 33.272 | 33.546 | 33.786 |
| Wt. per foot | | 125.0 | 138.0 | 152 0 | 167.0 | 200 0 | 220.0 | 240.0 | 260.0 |
| Area | | 36.75 | 40.58 | 44.69 | 49.12 | 58 82 | 64.70 | 70 58 | 76.47 |
| b" | | 12.000 | 12.056 | 12.115 | 12.179 | 16 000 | 16.046 | 16.090 | 16.150 |
| t | | .540 | .596 | .655 | .719 | .720 | .766 | .810 | .870 |
| h | | 31⅜ | 31⅜ | 31⅜ | 31⅜ | 30¾ | 30¾ | 30¾ | 30¾ |
| m | | .797 | .879 | .968 | 1 062 | 1 1255 | 1 2615 | 1.3985 | 1.5185 |
| k | | 4¾ | 4¾ | 4¾ | 4¾ | 6⅝ | 6⅝ | 6⅝ | 6⅝ |
| f | | 1" | 1" | 1" | 1" | 1" | 1" | 1" | 1" |
| c | | 29½ | 29½ | 29½ | 29½ | 28¾ | 28¾ | 28¾ | 28¾ |
| g | | 7½ | 7½ | 7½ | 7½ | 10" | 10" | 10" | 10" |
| AXES X-X | I | 6514.3 | 7223.0 | 7998.5 | 8836.1 | 11049.6 | 12385.5 | 13750.6 | 15037.7 |
| | S | 394.81 | 435.59 | 479.79 | 527.06 | 669.67 | 744.50 | 819.81 | 890.17 |
| | r | 13.31 | 13.34 | 13.38 | 13.41 | 13.71 | 13.84 | 13.96 | 14.02 |
| AXES Y-Y | I | 230.1 | 257.5 | 287.8 | 321.0 | 769.5 | 870.0 | 972.5 | 1068.0 |
| | S | 38.4 | 42.7 | 47.5 | 52.7 | 96.2 | 108.4 | 120.9 | 132.3 |
| | r | 2.50 | 2.52 | 2.54 | 2.56 | 3.62 | 3.67 | 3.71 | 3.74 |
| Coef. Str. | | 4737700 | 5227100 | 5757400 | 6324700 | 8036100 | 8934000 | 9837700 | 10682100 |
| Max. Mom." | | 7106500 | 7840700 | 8636100 | 9487000 | 12054100 | 13401000 | 14756500 | 16023100 |
| V | | 213800 | 237200 | 262100 | 289300 | 285100 | 305800 | 326100 | 352700 |
| P. feet | | 11 08 | 11.02 | 10.99 | 10.93 | 14.09 | 14.61 | 15.09 | 15.14 |
| R | | 70370 | 83420 | 97450 | 112860 | 112770 | 123930 | 134790 | 149460 |
| W | | 107370 | 107370 | 107370 | 107370 | 190880 | 190880 | 190880 | 190880 |
| Q. feet | | 22 06 | 24 34 | 26.81 | 29.45 | 21.05 | 23.40 | 25.77 | 27.98 |
| w. lbs | | 45 | 45 | 45 | 45 | 66 | 66 | 66 | 66 |
| Rivet dia | | 1" | 1" | 1" | 1" | 1" | 1" | 1" | 1" |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 395 | 395 | 436 | 436 | 480 | 480 | 527 | 527 | 570 | 570 | 612 | 612 | 652 | 652 | 705 | 705 | |
| 14 | 338 | 338 | 373 | 373 | 411 | 411 | 452 | 452 | 570 | 570 | 612 | 612 | 652 | 652 | 705 | 705 | |
| 16 | 296 | 292 | 327 | 322 | 360 | 356 | 395 | 391 | 502 | 502 | 558 | 558 | 615 | 615 | 668 | 668 | .144 |
| 18 | 263 | 252 | 290 | 278 | 320 | 307 | 351 | 337 | 446 | 446 | 496 | 496 | 547 | 547 | 593 | 593 | .183 |
| 20 | 237 | 219 | 261 | 242 | 288 | 268 | 316 | 294 | 402 | 401 | 447 | 447 | 492 | 492 | 534 | 534 | .226 |
| 21 | 226 | 205 | 249 | 227 | 274 | 251 | 301 | 275 | 383 | 378 | 425 | 421 | 468 | 463 | 509 | 505 | .249 |
| 22 | 215 | 193 | 238 | 213 | 262 | 235 | 288 | 258 | 365 | 357 | 406 | 397 | 447 | 437 | 486 | 477 | .273 |
| 23 | 206 | 181 | 227 | 200 | 250 | 221 | 275 | 243 | 349 | 338 | 388 | 376 | 428 | 414 | 464 | 451 | .298 |
| 24 | 197 | 170 | 218 | 188 | 240 | 208 | 264 | 228 | 335 | 320 | 372 | 356 | 410 | 392 | 445 | 427 | .325 |
| 25 | 190 | 160 | 209 | 177 | 230 | 196 | 253 | 215 | 321 | 304 | 357 | 338 | 391 | 372 | 427 | 405 | .353 |
| 26 | 182 | 151 | 201 | 167 | 221 | 185 | 243 | 204 | 309 | 289 | 344 | 321 | 378 | 353 | 411 | 385 | .381 |
| 27 | 175 | 143 | 194 | 158 | 213 | 174 | 234 | 193 | 298 | 274 | 331 | 305 | 364 | 336 | 396 | 366 | .411 |
| 28 | 169 | 135 | 187 | 150 | 206 | 165 | 226 | 182 | 287 | 261 | 319 | 290 | 351 | 320 | 382 | 349 | .442 |
| 29 | 163 | 128 | 180 | 142 | 199 | 156 | 218 | 172 | 277 | 249 | 308 | 277 | 339 | 305 | 368 | 332 | .475 |
| 30 | 158 | 121 | 174 | 134 | 192 | 148 | 211 | 163 | 268 | 238 | 298 | 264 | 328 | 292 | 356 | 317 | .508 |
| 31 | 153 | 115 | 169 | 127 | 186 | 140 | 204 | 155 | 259 | 227 | 288 | 252 | 317 | 279 | 345 | 303 | .542 |
| 32 | 148 | 109 | 163 | 121 | 180 | 133 | 198 | 147 | 251 | 217 | 279 | 241 | 307 | 266 | 334 | 289 | .578 |
| 33 | 144 | 103 | 158 | 115 | 174 | 126 | 192 | 139 | 244 | 207 | 271 | 230 | 298 | 255 | 324 | 277 | .614 |
| 34 | 139 | 98 | 154 | 109 | 169 | 120 | 186 | 132 | 236 | | 263 | | 289 | | 314 | | .652 |
| 35 | 135 | 93 | 149 | 103 | 165 | 114 | 181 | 126 | 230 | | 255 | | 281 | | 305 | | .691 |
| 36 | 132 | 89 | 145 | 98 | 160 | 108 | 176 | 120 | 223 | | 248 | | 273 | | 297 | | .731 |
| 38 | 125 | 80 | 138 | 89 | 152 | 98 | 166 | 109 | 211 | | 235 | | 259 | | 281 | | .815 |
| 40 | 118 | | 131 | 81 | 144 | 90 | 158 | 99 | 201 | | 223 | | 246 | | 267 | | .903 |
| 42 | 113 | | 124 | | 137 | | 151 | | 191 | | 213 | | 234 | | 254 | | .995 |
| 44 | 108 | | 119 | | 131 | | 144 | | 183 | | 203 | | 224 | | 243 | | 1.09 |
| 46 | 103 | | 114 | | 125 | | 138 | | 175 | | 194 | | 214 | | 232 | | 1 19 |
| 48 | 99 | | 109 | | 120 | | 132 | | 167 | | 186 | | 205 | | 223 | | 1.30 |
| 50 | 95 | | 105 | | 115 | | 127 | | 161 | | 179 | | 197 | | 214 | | 1.41 |
| 52 | 91 | | 101 | | 111 | | 122 | | 155 | | 172 | | 189 | | 205 | | 1 53 |
| 54 | 88 | | 97 | | 107 | | 117 | | 149 | | 165 | | 182 | | 198 | | 1 65 |
| 56 | 85 | | 93 | | 103 | | 113 | | 144 | | 160 | | 176 | | 191 | | 1 77 |
| 58 | 82 | | 90 | | 99 | | 109 | | 139 | | 154 | | 170 | | 184 | | 1.90 |




# CARNEGIE BEAMS

## DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets.

Rivet given is Maximum diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 36″ C

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d″. | | 36.000 | 36.183 | 36.395 | 36.645 | 36.000 | 36.243 | 36.550 | 36.851 |
| Wt. per foot. | | 147.0 | 160.0 | 175.0 | 192.0 | 230.0 | 250.0 | 275.0 | 300.0 |
| Area | | 43.23 | 47.06 | 51.47 | 56.47 | 67.65 | 73.53 | 80.87 | 88.23 |
| b″ | | 12.000 | 12.045 | 12.096 | 12.150 | 16.000 | 16.055 | 16.121 | 16.189 |
| t | | .590 | .635 | .686 | .740 | .769 | .824 | .890 | .958 |
| h | | 34⅛ | 34⅛ | 34⅛ | 34⅛ | 33⅜ | 33⅜ | 33⅜ | 33⅜ |
| m | | .9345 | 1.026 | 1.132 | 1.257 | 1.290 | 1.4115 | 1.565 | 1.7155 |
| k | | 4 11/16 | 4 11/16 | 4 11/16 | 4 11/16 | 6⅝ | 6⅝ | 6⅝ | 6⅝ |
| f | | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ |
| c | | 32¼ | 32¼ | 32¼ | 32¼ | 31½ | 31½ | 31½ | 31½ |
| g | | 7½ | 7½ | 7½ | 7½ | 10″ | 10″ | 10″ | 10″ |
| AXES X-X | I | 9040.4 | 9933.2 | 10978.8 | 12208.5 | 15012.9 | 16499.3 | 18400.2 | 20317.7 |
| | S | 502.24 | 549.05 | 603.31 | 666.31 | 834.05 | 910.48 | 1006.85 | 1102.69 |
| | r | 14.46 | 14.53 | 14.61 | 14.70 | 14.90 | 14.98 | 15.08 | 15.18 |
| AXES Y-Y | I | 269.9 | 299.8 | 335.0 | 377.2 | 882.2 | 975.4 | 1095.1 | 1215.9 |
| | S | 45.0 | 49.8 | 55.4 | 62.1 | 110.3 | 121.5 | 135.9 | 150.2 |
| | r | 2.50 | 2.52 | 2.55 | 2.58 | 3.61 | 3.64 | 3.68 | 3.71 |
| Coef. Str. | | 6026900 | 6588600 | 7239800 | 7995700 | 10008600 | 10925800 | 12082200 | 13232300 |
| Max.Mom.″ # | | 9040400 | 9883000 | 10859600 | 11993600 | 15012900 | 16388700 | 18123300 | 19848500 |
| V | | 254900 | 275700 | 299600 | 325400 | 332200 | 358400 | 390400 | 423600 |
| P. feet | | 11.82 | 11.95 | 12.08 | 12.29 | 15.06 | 15.24 | 15.48 | 15.62 |
| R | | 81940 | 93050 | 105870 | 119740 | 126690 | 140860 | 158030 | 175860 |
| W | | 107370 | 107370 | 107370 | 107370 | 190880 | 190880 | 190880 | 190880 |
| Q. feet | | 28.07 | 30.68 | 33.71 | 37.23 | 26.22 | 28.62 | 31.65 | 34.66 |
| w. lbs. | | 45 | 45 | 45 | 45 | 66 | 66 | 66 | 66 |
| Rivet dia | | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ | 1″ |

Live Load deflection must not exceed 1-360 of the Span.

Live Load Def. = Total Def. × Live Load / Tabular Load

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divided the Coefficient of Strength by Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; laterally fixed beam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 502 | 502 | 549 | 549 | 599 | 599 | 651 | 651 | 664 | 664 | 717 | 717 | 781 | 781 | 847 | 847 | |
| 14 | 430 | 430 | 471 | 471 | 517 | 517 | 571 | 571 | 664 | 664 | 717 | 717 | 781 | 781 | 847 | 847 | |
| 16 | 377 | 371 | 412 | 406 | 452 | 447 | 500 | 494 | 626 | 626 | 683 | 683 | 755 | 755 | 827 | 827 | .132 |
| 18 | 335 | 320 | 366 | 350 | 402 | 386 | 444 | 426 | 556 | 556 | 607 | 607 | 671 | 671 | 735 | 735 | .168 |
| 20 | 301 | 279 | 329 | 306 | 362 | 337 | 400 | 372 | 500 | 500 | 546 | 546 | 604 | 604 | 662 | 662 | .207 |
| 21 | 287 | 261 | 314 | 286 | 345 | 315 | 381 | 348 | 477 | 471 | 520 | 514 | 575 | 569 | 630 | 625 | .228 |
| 22 | 274 | 245 | 300 | 268 | 329 | 296 | 363 | 327 | 455 | 445 | 497 | 486 | 549 | 537 | 601 | 590 | .250 |
| 23 | 262 | 230 | 286 | 252 | 315 | 278 | 348 | 307 | 435 | 421 | 475 | 459 | 525 | 508 | 575 | 559 | .274 |
| 24 | 251 | 217 | 275 | 237 | 302 | 261 | 333 | 289 | 417 | 399 | 455 | 435 | 503 | 483 | 551 | 529 | .298 |
| 25 | 241 | 204 | 264 | 223 | 290 | 246 | 320 | 272 | 400 | 378 | 437 | 413 | 483 | 459 | 529 | 502 | .323 |
| 26 | 232 | 192 | 253 | 210 | 278 | 232 | 308 | 257 | 385 | 359 | 420 | 392 | 465 | 436 | 509 | 477 | .350 |
| 27 | 223 | 182 | 244 | 199 | 268 | 219 | 296 | 242 | 371 | 342 | 405 | 373 | 447 | 414 | 490 | 454 | .377 |
| 28 | 215 | 172 | 235 | 188 | 259 | 207 | 286 | 229 | 357 | 325 | 390 | 355 | 431 | 395 | 473 | 432 | .406 |
| 29 | 208 | 163 | 227 | 178 | 250 | 196 | 276 | 217 | 345 | 310 | 377 | 339 | 417 | 376 | 456 | 412 | .435 |
| 30 | 201 | 154 | 220 | 168 | 241 | 186 | 267 | 205 | 334 | 296 | 364 | 323 | 403 | 359 | 441 | 393 | .466 |
| 31 | 194 | 146 | 213 | 160 | 234 | 176 | 258 | 196 | 323 | 282 | 352 | 308 | 390 | 342 | 427 | 375 | .497 |
| 32 | 188 | 138 | 206 | 151 | 226 | 167 | 250 | 186 | 313 | 270 | 341 | 295 | 378 | 327 | 414 | 358 | .530 |
| 33 | 183 | 131 | 200 | 144 | 219 | 159 | 242 | 176 | 303 | 258 | 331 | 282 | 366 | 313 | 401 | 343 | .563 |
| 34 | 177 | 125 | 194 | 137 | 213 | 151 | 235 | 167 | 294 | 247 | 321 | 269 | 355 | 299 | 389 | 328 | .598 |
| 35 | 172 | 119 | 188 | 130 | 207 | 143 | 228 | 159 | 286 | 236 | 312 | 258 | 345 | 287 | 378 | 314 | .634 |
| 36 | 167 | 113 | 183 | 124 | 201 | 136 | 222 | 151 | 278 | 226 | 304 | 247 | 336 | 275 | 368 | 301 | .670 |
| 38 | 159 | 102 | 173 | 113 | 191 | 124 | 210 | 137 | 263 | 208 | 288 | 227 | 318 | 253 | 348 | 277 | .747 |
| 40 | 151 | | 165 | 102 | 181 | 112 | 200 | 125 | 250 | 192 | 273 | 209 | 302 | 233 | 331 | 255 | .828 |
| 42 | 143 | | 157 | | 172 | | 190 | | 238 | 177 | 260 | 193 | 288 | 215 | 315 | 235 | .912 |
| 44 | 137 | | 150 | | 165 | | 182 | | 227 | 164 | 248 | 179 | 275 | 199 | 301 | 219 | 1.00 |
| 46 | 131 | | 143 | | 157 | | 174 | | 218 | 152 | 238 | 165 | 263 | 184 | 288 | 203 | 1.09 |
| 48 | 126 | | 137 | | 151 | | 167 | | 209 | 141 | 228 | 153 | 252 | 171 | 276 | 188 | 1.19 |
| 50 | 121 | | 132 | | 145 | | 160 | | 200 | 131 | 219 | 143 | 242 | 159 | 265 | 175 | 1.29 |
| 52 | 116 | | 127 | | 139 | | 154 | | 192 | 121 | 210 | 133 | 232 | 147 | 254 | 162 | 1.40 |
| 54 | 112 | | 122 | | 134 | | 148 | | 185 | | 202 | | 224 | | 245 | | 1.51 |
| 56 | 108 | | 118 | | 129 | | 143 | | 179 | | 195 | | 216 | | 236 | | 1.62 |
| 58 | 104 | | 114 | | 125 | | 138 | | 173 | | 188 | | 208 | | 228 | | 1.74 |
| 60 | 100 | | 110 | | 121 | | 133 | | 167 | | 182 | | 201 | | 221 | | 1.86 |

# ALLOWABLE END REACTIONS FOR CARNEGIE BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 3½" Bearing | Min. Span for 3½" Bearing | Reaction R for 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 24.0 | .239" | 15000 | 19720 | 6.41′ | 26890 | 3590 | 22900 | 4.40 |
| | 27.0 | .268 | 15000 | 22210 | 6.40 | 30250 | 4020 | 26000 | 4.45 |
| | 30.0 | .298 | 15000 | 24800 | 6.37 | 33740 | 4470 | 29300 | 4.51 |
| | 31.0 | .290 | 15000 | 23990 | 6.88 | 32690 | 4350 | 28100 | 4.43 |
| | 36.0 | .336 | 15000 | 27970 | 6.87 | 38050 | 5040 | 33100 | 4.51 |
| | 42.0 | .390 | 15000 | 32700 | 6.86 | 44400 | 5850 | 39100 | 4.60 |
| 9 | 29.0 | .279 | 15000 | 24060 | 6.98 | 32430 | 4190 | 30100 | 4.95 |
| | 32.0 | .307 | 15000 | 26590 | 6.97 | 35800 | 4610 | 33500 | 5.00 |
| | 35.0 | .335 | 15000 | 29130 | 6.96 | 39180 | 5030 | 37000 | 5.06 |
| | 38.0 | .316 | 15000 | 27250 | 8.34 | 36730 | 4740 | 34100 | 4.95 |
| | 43.0 | .357 | 15000 | 30950 | 8.31 | 41660 | 5360 | 39100 | 5.02 |
| | 48.0 | .398 | 15000 | 34690 | 8.28 | 46630 | 5970 | 44100 | 5.08 |
| 10 | 21.0 | .230 | 13750 | 18900 | 6.90 | 25220 | 3160 | 27300 | 6.17 |
| | 23.0 | .230 | 13690 | 18890 | 7.76 | 25190 | 3150 | 27600 | 6.27 |
| | 26.0 | .259 | 14360 | 22410 | 7.40 | 29850 | 3720 | 31400 | 5.91 |
| | 30.0 | .298 | 15000 | 27070 | 7.07 | 36010 | 4470 | 36600 | 5.63 |
| | 31.0 | .320 | 15000 | 28800 | 6.81 | 38400 | 4800 | 38400 | 5.50 |
| | 36.0 | .467 | 15000 | 42030 | 5.01 | 56040 | 7010 | 56000 | 5.50 |
| | 42.0 | .644 | 15000 | 57960 | 3.94 | 77280 | 9660 | 77300 | 5.50 |
| | 49.0 | .350 | 15000 | 31500 | 10.36 | 42000 | 5250 | 42000 | 5.50 |
| | 54.0 | .497 | 15000 | 44730 | 7.63 | 59640 | 7460 | 59600 | 5.50 |
| | 59.0 | .644 | 15000 | 57960 | 6.14 | 77280 | 9660 | 77300 | 5.50 |
| | 64.0 | .791 | 15000 | 71190 | 5.21 | 94920 | 11870 | 94900 | 5.50 |
| 12 | 25.0 | .240 | 12750 | 19840 | 9.28 | 25960 | 3060 | 34300 | 8.24 |
| | 28.0 | .240 | 12710 | 19820 | 10.77 | 25920 | 3050 | 34600 | 8.33 |
| | 32.0 | .274 | 13580 | 24290 | 10.04 | 31730 | 3720 | 39800 | 7.68 |
| | *34.0 | .375 | 15000 | 36590 | 6.50 | 47840 | 5630 | 54100 | 6.61 |
| | 36.0 | .308 | 14250 | 28790 | 9.54 | 37570 | 4390 | 45200 | 7.24 |
| | 40.0 | .290 | 14000 | 26400 | 11.88 | 34520 | 4060 | 41800 | 7.28 |
| | 45.0 | .326 | 14630 | 31140 | 11.34 | 40680 | 4770 | 47500 | 6.92 |
| | 50.0 | .361 | 15000 | 35550 | 11.03 | 46380 | 5420 | 53100 | 6.74 |
| | 55.0 | .375 | 15000 | 36560 | 11.72 | 47810 | 5630 | 54000 | 6.60 |
| | 60.0 | .409 | 15000 | 40060 | 11.67 | 52330 | 6140 | 59500 | 6.67 |
| | 66.0 | .448 | 15000 | 44120 | 11.66 | 57560 | 6720 | 65900 | 6.74 |
| | 65.0 | .400 | 15000 | 39000 | 13.37 | 51000 | 6000 | 57600 | 6.60 |
| | 70.0 | .523 | 15000 | 50990 | 10.57 | 66680 | 7850 | 75300 | 6.60 |
| | 76.0 | .670 | 15000 | 65330 | 8.57 | 85430 | 10050 | 96500 | 6.60 |

The beam web is treated as a column with fixed ends, having an effective length $l$ of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

*Special Section. Web Thickness ⅜"

# ALLOWABLE END REACTIONS FOR CARNEGIE BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 3½" Bearing | Min. Span for 3½" Bearing | Reaction R for 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 30.0 | .270 | 12450 | 23500 | 10.68′ | .30220 | 3360 | 45200 | 9.97 |
| | 33.0 | .270 | 12430 | 23490 | 12.17 | 30200 | 3360 | 45400 | 10.02 |
| | 36.0 | .294 | 13020 | 26880 | 11.59 | 34540 | 3830 | 49700 | 9.46 |
| | *38.0 | .375 | 14610 | 38340 | 7.99 | 49300 | 5480 | 63000 | 8.00 |
| | 39.0 | .318 | 13530 | 30290 | 11.14 | 38890 | 4300 | 54000 | 9.02 |
| | 42.0 | .342 | 13970 | 33720 | 10.78 | 43280 | 4780 | 58400 | 8.68 |
| | 48.0 | .343 | 14090 | 33820 | 11.57 | 43480 | 4830 | 57600 | 8.43 |
| | 53.0 | .378 | 14600 | 38810 | 12.10 | 49850 | 5520 | 64100 | 8.07 |
| | 58.0 | .413 | 15000 | 43740 | 11.74 | 56130 | 6200 | 70600 | 7.83 |
| | 61.0 | .382 | 14670 | 39360 | 14.20 | 50560 | 5600 | 64600 | 8.01 |
| | 68.0 | .425 | 15000 | 45000 | 13.84 | 57750 | 6380 | 72600 | 7.83 |
| | 75.0 | .468 | 15000 | 49810 | 13.79 | 63850 | 7020 | 80800 | 7.91 |
| | 85.0 | .435 | 15000 | 45670 | 17.29 | 58720 | 6530 | 73100 | 7.70 |
| | 95.0 | .485 | 15000 | 51260 | 17.23 | 65810 | 7280 | 82600 | 7.80 |
| | 105.0 | .536 | 15000 | 57020 | 17.13 | 73100 | 8040 | 92400 | 7.90 |
| 16 | 35.0 | .290 | 11980 | 25990 | 12.62 | 32930 | 3470 | 55400 | 11.98 |
| | 38.0 | .314 | 12560 | 29590 | 12.03 | 37470 | 3940 | 60300 | 11.30 |
| | 40.0 | .290 | 11940 | 25970 | 15.15 | 32890 | 3460 | 55700 | 12.08 |
| | *43.0 | .375 | 13840 | 38830 | 10.16 | 49210 | 5190 | 71700 | 9.84 |
| | 45 0 | .326 | 12790 | 31390 | 14.10 | 39730 | 4170 | 63100 | 11.11 |
| | 50.0 | .362 | 13470 | 36890 | 13.33 | 46650 | 4880 | 70600 | 10.41 |
| | 58.0 | .375 | 13810 | 38840 | 15.00 | 49200 | 5180 | 72000 | 9.90 |
| | 63.0 | .406 | 14260 | 43580 | 14.52 | 55160 | 5790 | 78500 | 9.54 |
| | 68.0 | .438 | 14650 | 48480 | 14.09 | 61320 | 6420 | 85300 | 9.24 |
| | 76.0 | .419 | 14480 | 45510 | 17.49 | 57650 | 6070 | 80500 | 9.26 |
| | 83.0 | .458 | 14920 | 51450 | 16.90 | 65110 | 6830 | 88600 | 8.94 |
| | 90.0 | .495 | 15000 | 56130 | 16.79 | 70990 | 7430 | 96500 | 8.93 |
| | 100.0 | .464 | 15000 | 52200 | 20.50 | 66120 | 6960 | 89100 | 8.80 |
| | 107.0 | .496 | 15000 | 56000 | 20.45 | 70880 | 7440 | 95900 | 8.86 |
| | 115.0 | .532 | 15000 | 60320 | 20.41 | 76280 | 7980 | 103700 | 8.93 |

The beam web is treated as a column with fixed ends, having an effective length $l$ of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

*Special Section. Web Thickness ⅜".

# ALLOWABLE END REACTIONS FOR CARNEGIE BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 3½" Bearing | Min. Span for 3½" Bearing | Reaction R for 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 18 | 47.0 | .320 | 11790 | 30170 | 16.98′ | 37710 | 3770 | 69100 | 13.83 |
| | *51.0 | .375 | 13000 | 39020 | 13.82 | 48780 | 4880 | 81100 | 12.14 |
| | 52.0 | .354 | 12530 | 35610 | 15.91 | 44490 | 4440 | 77000 | 12.82 |
| | 58.0 | .393 | 13240 | 41950 | 15.06 | 52350 | 5200 | 86100 | 11.98 |
| | 67.0 | .406 | 13560 | 44040 | 16.91 | 55060 | 5510 | 87700 | 11.43 |
| | 72.0 | .436 | 13980 | 48930 | 16.36 | 61130 | 6100 | 94800 | 11.02 |
| | 78.0 | .471 | 14400 | 54670 | 15.87 | 68230 | 6780 | 103100 | 10 64 |
| | 86.0 | .429 | 13920 | 47760 | 21.13 | 59700 | 5970 | 92700 | 11.02 |
| | 93 0 | .463 | 14340 | 53310 | 20.48 | 66590 | 6640 | 100700 | 10.63 |
| | 100.0 | .498 | 14710 | 59040 | 19.88 | 73700 | 7330 | 109000 | 10.32 |
| 21 | 55.0 | .360 | 11530 | 36210 | 18.51 | 44510 | 4150 | 90200 | 16 52 |
| | 58.0 | .360 | 11490 | 36180 | 19.95 | 44460 | 4140 | 90700 | 16.69 |
| | 64.0 | .396 | 12210 | 42460 | 18 77 | 52140 | 4840 | 100400 | 15 48 |
| | 70.0 | .433 | 12850 | 49010 | 17.78 | 60130 | 5560 | 110400 | 14 54 |
| | 76.0 | .469 | 13370 | 55460 | 17.05 | 68000 | 6270 | 120300 | 13 83 |
| | 80.0 | .438 | 13010 | 49880 | 18.45 | 61280 | 5700 | 110400 | 14 11 |
| | 86.0 | .470 | 13470 | 55580 | 19.83 | 68240 | 6330 | 119100 | 13.54 |
| | 92 0 | .502 | 13860 | 61320 | 19.22 | 75240 | 6960 | 128000 | 13.07 |
| | 98.0 | .535 | 14220 | 67260 | 18.67 | 82480 | 7610 | 137100 | 12.68 |
| | 104.0 | .465 | 13430 | 54660 | 25.88 | 67140 | 6240 | 117200 | 13.51 |
| | 112.0 | .499 | 13860 | 60730 | 25.10 | 74570 | 6920 | 126500 | 13.01 |
| | 120.0 | .535 | 14250 | 67190 | 24.30 | 82430 | 7620 | 136400 | 12.58 |
| | 128.0 | .570 | 14580 | 73500 | 23.71 | 90120 | 8310 | 146200 | 12.24 |
| | 136.0 | .606 | 14880 | 80020 | 23.12 | 98060 | 9020 | 156300 | 11.96 |
| 24 | 70.0 | .400 | 11250 | 42750 | 22.85 | 51750 | 4500 | 115200 | 19.60 |
| | 76.0 | .405 | 11350 | 43680 | 25.00 | 52880 | 4600 | 116600 | 19.37 |
| | 85.0 | .452 | 12200 | 52580 | 23 22 | 63600 | 5510 | 131000 | 17.73 |
| | 94.0 | .499 | 12900 | 61640 | 21 90 | 74520 | 6440 | 145600 | 16.54 |
| | 100.0 | .450 | 12210 | 52200 | 28.93 | 63180 | 5490 | 129600 | 17 59 |
| | 110.0 | .494 | 12870 | 60650 | 27.39 | 73370 | 6360 | 143200 | 16 48 |
| | 120.0 | .539 | 13440 | 69400 | 26.10 | 83880 | 7240 | 157200 | 15.62 |
| | 130.0 | .547 | 13560 | 70920 | 28.23 | 85760 | 7420 | 159200 | 15.40 |
| | 140.0 | .588 | 13990 | 78940 | 27 30 | 95400 | 8230 | 172100 | 14 82 |
| | 150 0 | .629 | 14360 | 87000 | 26.55 | 105600 | 9030 | 185100 | 14 36 |
| | 160.0 | 670 | 14680 | 95100 | 25.92 | 114780 | 9840 | 198300 | 13 99 |

The beam web is treated as a column with fixed ends, having an effective length $l$ of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

*Special Section. Web Thickness ⅜".

# ALLOWABLE END REACTIONS FOR CARNEGIE BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

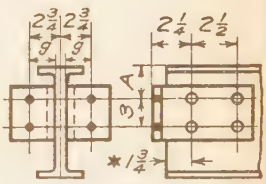
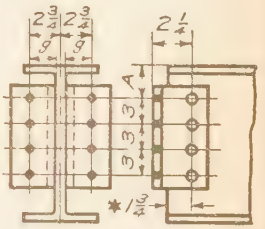
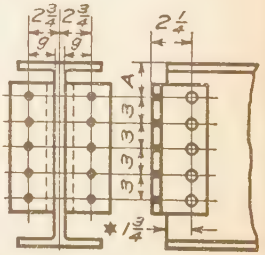
| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 3½" Bearing | Min. Span for 3½" Bearing | Reaction R for 5½" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 27 | 85.0 | .461 | 11510 | 54140 | 23.96 | 64750 | 5305 | 148400 | 21.26 |
| | 91.0 | .461 | 11450 | 54120 | 26.42 | 64680 | 5280 | 149400 | 21.54 |
| | 101.0 | .510 | 12220 | 64140 | 24.76 | 76600 | 6230 | 166300 | 19.88 |
| | 112.0 | .566 | 12960 | 75810 | 23.20 | 90490 | 7340 | 185700 | 18.48 |
| | 124.0 | .624 | 13590 | 88050 | 22.14 | 105000 | 8480 | 206200 | 17.43 |
| | 137.0 | .688 | 14160 | 101660 | 21.17 | 121150 | 9740 | 229000 | 16.57 |
| | 145.0 | .580 | 13220 | 78620 | 31.14 | 93960 | 7670 | 187900 | 17.75 |
| | 160.0 | .639 | 13830 | 90990 | 29.68 | 108670 | 8840 | 208600 | 16.81 |
| | 175.0 | .698 | 14320 | 103470 | 28.56 | 123470 | 10000 | 229500 | 16.11 |
| | 190.0 | .756 | 14730 | 115800 | 27.70 | 138080 | 11140 | 250400 | 15.59 |
| 30 | 115.0 | .530 | 11730 | 68410 | 29.15 | 80850 | 6220 | 190800 | 23.18 |
| | 126.0 | .581 | 12420 | 79670 | 27.40 | 94100 | 7220 | 210300 | 21.60 |
| | 138.0 | .634 | 13030 | 91550 | 26.13 | 108060 | 8260 | 230900 | 20.37 |
| | 151.0 | .692 | 13590 | 104700 | 25.01 | 123500 | 9400 | 253600 | 19.34 |
| | 165.0 | .755 | 14100 | 119090 | 24.01 | 140390 | 10650 | 278500 | 18.47 |
| | 180.0 | .670 | 13490 | 99440 | 33.39 | 117520 | 9040 | 241200 | 19.18 |
| | 200.0 | .743 | 14100 | 115940 | 31.83 | 136900 | 10480 | 269800 | 18.19 |
| | 220.0 | .816 | 14600 | 132570 | 30.61 | 156390 | 11910 | 298900 | 17.46 |
| | 240.0 | .888 | 15000 | 149090 | 29.69 | 175730 | 13320 | 328000 | 16.93 |
| 33 | 125.0 | .540 | 11090 | 70370 | 33.66 | 82340 | 5990 | 213800 | 27.45 |
| | 138.0 | .596 | 11870 | 83420 | 31.33 | 97560 | 7070 | 237200 | 25.24 |
| | 152.0 | .655 | 12570 | 97450 | 29.54 | 113910 | 8230 | 262100 | 23.50 |
| | 167.0 | .719 | 13210 | 112860 | 28.02 | 131860 | 9500 | 289300 | 22.08 |
| | 200.0 | .720 | 13330 | 112770 | 35.63 | 131970 | 9600 | 285100 | 21.46 |
| | 220.0 | .766 | 13690 | 123930 | 36.04 | 144900 | 10490 | 305800 | 20.84 |
| | 240.0 | .810 | 14000 | 134790 | 36.49 | 157470 | 11340 | 326100 | 20.37 |
| | 260.0 | .870 | 14380 | 149460 | 35.74 | 174480 | 12510 | 352700 | 19.75 |
| 36 | 147.0 | .590 | 11110 | 81940 | 36.78 | 95050 | 6550 | 254900 | 29.89 |
| | 160.0 | .635 | 11680 | 93050 | 35.41 | 107880 | 7420 | 275700 | 28.13 |
| | 175.0 | .686 | 12250 | 105870 | 34.19 | 122680 | 8400 | 299600 | 26.56 |
| | 192.0 | .740 | 12780 | 119740 | 33.39 | 138650 | 9460 | 325400 | 25.25 |
| | 230.0 | .769 | 13180 | 126690 | 39.50 | 146960 | 10140 | 332200 | 23.78 |
| | 250.0 | .824 | 13610 | 140860 | 38.78 | 163290 | 11210 | 358400 | 22.90 |
| | 275.0 | .890 | 14050 | 158030 | 38.23 | 183030 | 12500 | 390400 | 22.08 |
| | 300.0 | .958 | 14440 | 175860 | 37.62 | 203530 | 13830 | 423600 | 21.41 |

The beam web is treated as a column with fixed ends, having an effective length $l$ of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

# CONNECTION ANGLES FOR CARNEGIE BEAMS

DIMENSIONS, WEIGHTS AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

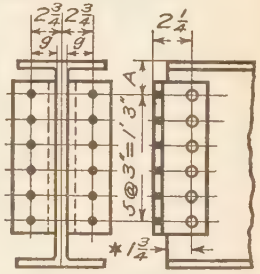
| Beam Depth | Beam Weight per foot | Connection Value: Outstanding Single Shear: Web | Connection Value: Outstanding Single Shear: Power Driven Rivets | Connection Value: Outstanding Single Shear: Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Weight inc. Web Rivets | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| 8" | 24.0 | 21510 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | 6" × 4" × 3/8" 0' — 5 1/2" Long | 13 lbs. |  |
| | 27.0 | 24120 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 30.0 | 26820 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| 9" | 29.0 | 25110 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 32.0 | 27630 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 35.0 | 30150 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| 10" | 21.0 | 20700 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 23 0 | 20700 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 26.0 | 23310 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 30.0 | 26820 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| 12" | 25.0 | 21600 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 28.0 | 21600 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 32 0 | 24660 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 34.0 | 33750 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 36 0 | 27720 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 40 0 | 26120 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| | 45 0 | 29340 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| | 50.0 | 32490 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| 14" | 30 0 | 24300 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | 4" × 3 1/2" × 3/8" 0' — 11 1/2" Long | 19 lbs. |  |
| | 33 0 | 24300 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 36 0 | 26460 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 38 0 | 33750 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 39 0 | 28620 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 42 0 | 30780 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| 16" | 35 0 | 26100 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 38 0 | 28260 | 47720 | 35340 | 1/4 | IC.19.10 | 2 5/8 | | | |
| | 40 0 | 26100 | 47720 | 35340 | 3/16 | IC.19.10 | 2 5/8 | | | |
| | 43 0 | 33750 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 45 0 | 29340 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| | 50 0 | 32580 | 47720 | 35340 | 1/4 | IC.19. 9 | 2 9/16 | | | |
| 18" | 47 0 | 36000 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | 4" × 3 1/2" × 3/8" 1' — 2 1/2" Long | 25 lbs. |  |
| | 51 0 | 42190 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 52 0 | 39830 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |
| | 58 0 | 44220 | 59650 | 44180 | 1/4 | IC.25. 9 | 2 9/16 | | | |

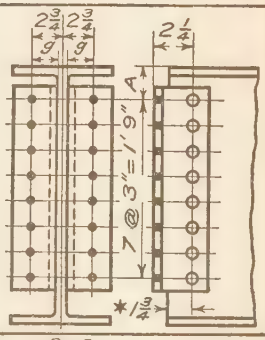
*Layer-out starts with this dimension at left end of beam. With beams ordered one inch short, as usual in standard shop practice, this leaves sufficient end distance or clearance at right end, in case of full allowable 3/8" underrun or 3/8" overrun in beam lengths.

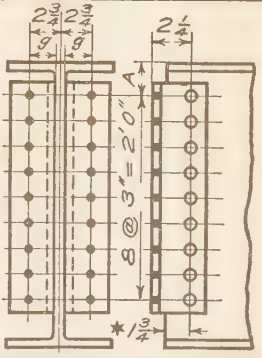
# CONNECTION ANGLES FOR CARNEGIE BEAMS

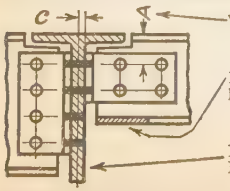
DIMENSIONS, WEIGHTS AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

| Beam | | Connection Value | | | Framing Distance | Connection Angles | | | | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Outstanding Single Shear | | | | | | | |
| Depth | Weight per foot | Web | Power Driven Rivets | Unfinished Bolts | C | A.I.S.C. Mark | Gage g | Size and Length | Weight inc. Web Rivets | |
| 21" | 55.0 | 48600 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | 4" × 3½" × 3/8" 1' — 5½" Long | 30 lbs. | |
| | 58.0 | 48600 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 64.0 | 53460 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 70.0 | 58460 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 76.0 | 63320 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| | 80.0 | 59130 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| | 86.0 | 63450 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| | 92.0 | 67770 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| | 98.0 | 71580 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| 24" | 70.0 | 54000 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 76.0 | 54680 | 71580 | 53020 | 1/4 | IC.30. 9 | 2 9/16 | | | |
| | 85.0 | 61020 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| | 94.0 | 67370 | 71580 | 53020 | 5/16 | IC.30. 8 | 2 1/2 | | | |
| 27" | 85.0 | 82980 | 95440 | 70690 | 5/16 | IC.40. 8 | 2 1/2 | 4" × 3½" × 3/8" 1' — 11½" Long | 40 lbs. | |
| | 91.0 | 82980 | 95440 | 70690 | 5/16 | IC.40. 8 | 2 1/2 | | | |
| | 101.0 | 91800 | 95440 | 70690 | 5/16 | IC.40. 8 | 2 1/2 | | | |
| | 112.0 | 95440 | 95440 | 70690 | 3/8 | IC.40. 8 | 2 1/2 | | | |
| | 124.0 | 95440 | 95440 | 70690 | 3/8 | IC.40. 7 | 2 7/16 | | | |
| | 137.0 | 95440 | 95440 | 70690 | 7/16 | IC.40. 6 | 2 3/8 | | | |
| 30" | 115.0 | 107330 | 107370 | 79530 | 5/16 | IC.45. 8 | 2 1/2 | 4" × 3½" × 3/8" 2' — 2½" Long | 45 lbs. | |
| | 126.0 | 107370 | 107370 | 79530 | 5/16 | IC.45. 7 | 2 7/16 | | | |
| | 138.0 | 107370 | 107370 | 79530 | 5/16 | IC.45. 7 | 2 7/16 | | | |
| | 151.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 6 | 2 3/8 | | | |
| | 165.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 6 | 2 3/8 | | | |
| 33" | 125.0 | 107370 | 107370 | 79530 | 5/16 | IC.45. 8 | 2 1/2 | | | |
| | 138.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 7 | 2 7/16 | | | |
| | 152.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 7 | 2 7/16 | | | |
| | 167.0 | 107370 | 107370 | 79530 | 7/16 | IC.45. 6 | 2 3/8 | | | |
| 36" | 147.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 7 | 2 7/16 | | | |
| | 160.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 7 | 2 7/16 | | | |
| | 175.0 | 107370 | 107370 | 79530 | 3/8 | IC.45. 7 | 2 7/16 | | | |
| | 192.0 | 107370 | 107370 | 79530 | 7/16 | IC.45. 6 | 2 3/8 | | | |




When A = 3" all beams can be framed opposite with tops flush.

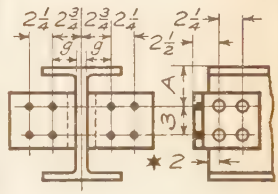
Flange must be cut away as shown for field riveting on all beams framing opposite a larger beam, if flange interferes with outstanding rivets.

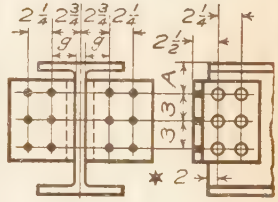
Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

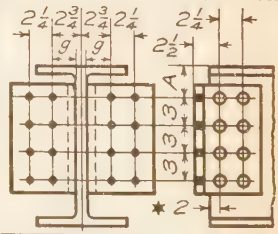
# CONNECTION ANGLES FOR CARNEGIE BEAMS

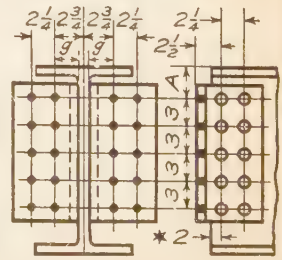
DIMENSIONS, WEIGHTS AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value: Outstanding, Single Shear: Web | Power Driven Rivets | Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Gage g | Size and Length | Weight inc. Web Rivets | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| 8" | 31.0 | 26100 | 47720 | 35340 | 3/16 | IC 16.10 | 2 5/8 | 6" × 6" × 3/8" 0' — 5 1/2" Long | 16 lbs. | |
| | 36.0 | 30240 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| | 42.0 | 35100 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| 9" | 38.0 | 28440 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| | 43.0 | 32130 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| | 48.0 | 35820 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| 10" | 31.0 | 28800 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| | 36.0 | 42030 | 47720 | 35340 | 5/16 | IC 16.8 | 2 1/2 | | | |
| | 42.0 | 47720 | 47720 | 35340 | 3/8 | IC 16.7 | 2 7/16 | | | |
| | 49.0 | 31520 | 47720 | 35340 | 1/4 | IC 16.9 | 2 9/16 | | | |
| | 54.0 | 44730 | 47720 | 35340 | 5/16 | IC 16.8 | 2 1/2 | | | |
| | 59.0 | 47720 | 47720 | 35340 | 3/8 | IC 16.7 | 2 7/16 | | | |
| | 64.0 | 47720 | 47720 | 35340 | 7/16 | IC 16.6 | 2 3/8 | | | |
| 12" | 55.0 | 50640 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | 6" × 6" × 3/8" 0' — 8 1/2" Long | 24 lbs. | |
| | 60.0 | 55220 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 66.0 | 60480 | 71580 | 53020 | 5/16 | IC 24.8 | 2 1/2 | | | |
| | 65.0 | 54000 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 70.0 | 70610 | 71580 | 53020 | 5/16 | IC 24.8 | 2 1/2 | | | |
| | 76.0 | 71580 | 71580 | 53020 | 3/8 | IC 24.7 | 2 7/16 | | | |
| 14" | 48.0 | 46300 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 53.0 | 51030 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 58.0 | 55760 | 71580 | 53020 | 1/4 | IC 24.10 | 2 5/8 | | | |
| | 61.0 | 51570 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 68.0 | 57370 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 75.0 | 63180 | 71580 | 53020 | 5/16 | IC 24.8 | 2 1/2 | | | |
| | 85.0 | 58730 | 71580 | 53020 | 1/4 | IC 24.9 | 2 9/16 | | | |
| | 95.0 | 65470 | 71580 | 53020 | 5/16 | IC 24.8 | 2 1/2 | | | |
| | 105.0 | 71580 | 71580 | 53020 | 5/16 | IC 24.8 | 2 1/2 | | | |
| 16" | 58.0 | 67800 | 95440 | 70690 | 1/4 | IC 33.9 | 2 9/16 | 6" × 6" × 3/8" 0' — 11 1/2" Long | 33 lbs. | |
| | 63.0 | 73080 | 95440 | 70690 | 1/4 | IC 33.9 | 2 9/16 | | | |
| | 68.0 | 78840 | 95440 | 70690 | 5/16 | IC 33.9 | 2 9/16 | | | |
| | 76.0 | 75420 | 95440 | 70690 | 1/4 | IC 33.9 | 2 9/16 | | | |
| | 83.0 | 82440 | 95440 | 70690 | 5/16 | IC 33.8 | 2 1/2 | | | |
| | 90.0 | 89100 | 95440 | 70690 | 5/16 | IC 33.8 | 2 1/2 | | | |
| | 100.0 | 83520 | 95440 | 70690 | 5/16 | IC 33.8 | 2 1/2 | | | |
| | 107.0 | 89280 | 95440 | 70690 | 5/16 | IC 33.8 | 2 1/2 | | | |
| | 115.0 | 95440 | 95440 | 70690 | 5/16 | IC 33.8 | 2 1/2 | | | |
| 18" | 67.0 | 91350 | 119300 | 88360 | 1/4 | IC 41.9 | 2 9/16 | 6" × 6" × 3/8" 1' — 2 1/2" Long | 41 lbs. | |
| | 72.0 | 98100 | 119300 | 88360 | 1/4 | IC 41.9 | 2 9/16 | | | |
| | 78.0 | 105980 | 119300 | 88360 | 5/16 | IC 41.8 | 2 1/2 | | | |
| | 86.0 | 96530 | 119300 | 88360 | 1/4 | IC 41.9 | 2 9/16 | | | |
| | 93.0 | 104180 | 119300 | 88360 | 5/16 | IC 41.8 | 2 1/2 | | | |
| | 100.0 | 112050 | 119300 | 88360 | 5/16 | IC 41.8 | 2 1/2 | | | |
| 21" | 104.0 | 104630 | 119300 | 88360 | 5/16 | IC 41.8 | 2 1/2 | | | |
| | 112.0 | 112280 | 119300 | 88360 | 5/16 | IC 41.8 | 2 1/2 | | | |
| | 120.0 | 119300 | 119300 | 88360 | 5/16 | IC 41.8 | 2 1/2 | | | |
| | 128.0 | 119300 | 119300 | 88360 | 3/8 | IC 41.7 | 2 7/16 | | | |
| | 136.0 | 119300 | 119300 | 88360 | 3/8 | IC 41.7 | 2 7/16 | | | |



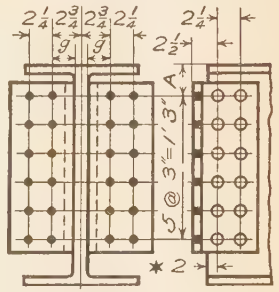
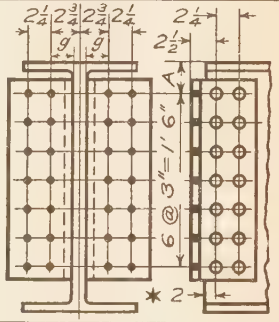
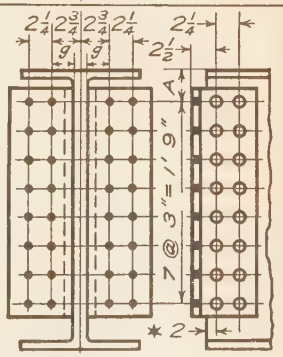



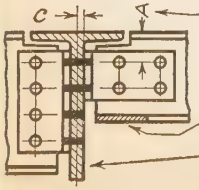




* Layout starts with this dimension at left end of beam. With beams ordered one inch short, as usual in standard shop practice, this leaves sufficient end distance or clearance at right end, in case of full allowable 3/8" underrun or 3/8" overrun in beam lengths.

# CONNECTION ANGLES FOR CARNEGIE BEAMS

DIMENSIONS, WEIGHTS AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value: Web | Connection Value: Outstanding Single Shear: Power Driven Rivets | Connection Value: Outstanding Single Shear: Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Weight inc. Web Rivets | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| 24" | 100.0 | 121500 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | 6" × 6" × 3/8" 1' — 5 1/2" Long | 49 lbs. |  |
| | 110.0 | 133380 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 120.0 | 143160 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 130.0 | 143160 | 143160 | 106030 | 5/16 | IC.49. 8 | 2 1/2 | | | |
| | 140.0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| | 150 0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| | 160 0 | 143160 | 143160 | 106030 | 3/8 | IC.49. 7 | 2 7/16 | | | |
| 27" | 145.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | 6" × 6" × 3/8" 1' — 8 1/2" Long | 58 lbs. |  |
| | 160.0 | 167020 | 167020 | 123700 | 3/8 | IC.58. 7 | 2 7/16 | | | |
| | 175.0 | 167020 | 167020 | 123700 | 7/16 | IC.58. 6 | 2 3/8 | | | |
| | 190.0 | 167020 | 167020 | 123700 | 7/16 | IC.58. 6 | 2 3/8 | | | |
| 30" | 180.0 | 190880 | 190880 | 141380 | 3/8 | IC.66. 7 | 2 7/16 | 6" × 6" × 3/8" 1' — 11 1/2" Long | 66 lbs. |  |
| | 200.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 220.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 240.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| 33" | 200.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 220.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 240.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 260.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| 36" | 230.0 | 190880 | 190880 | 141380 | 7/16 | IC.66. 6 | 2 3/8 | | | |
| | 250.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 275.0 | 190880 | 190880 | 141380 | 1/2 | IC.66. 5 | 2 5/16 | | | |
| | 300.0 | 190880 | 190880 | 141380 | 9/16 | IC.66. 4 | 2 1/4 | | | |



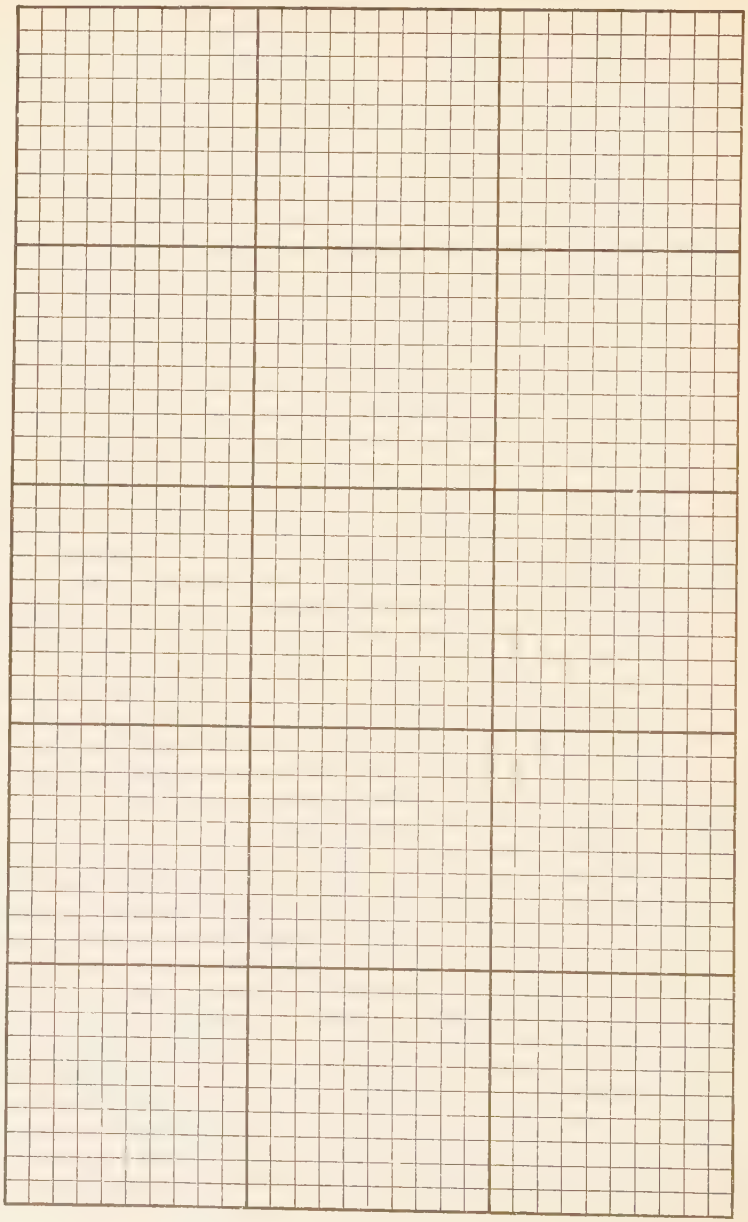

Following Beams can be framed opposite with tops flush when:—

A = 3" all 8", 9", 10", 12", 14", 16", 18", 21", and 24" (100 to 130#)
A = 3 1/4" all 9", 10", 12", 14", 16", 18", 21", 24", and 27" (145 and 160#)
A = 3 1/2" all 9", 10", 12" (40 to 50#), 14", 16", 21", 24", 27", and 30" (180 and 200#)
A = 3 3/4" all 9", 10", 14", 16", 21", 24", 27", and 30".

Flange must be cut away as shown for field riveting on all beams framing opposite a larger beam, if flange interferes with outstanding rivets.

Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

## NOTES and DIAGRAMS



# Part IV
# Section 8

## Miscellaneous Beam Sections

Dimensions
Technical Functions
Allowable Total Loads
by
A. I. S. C. Specification
Allowable End Reactions
Standard Connection Angles
for

Carnegie Mill Sections

Carnegie H Sections

J. and L. Junior Beams

Bethlehem Steel Joists

Phoenix Special I Beams

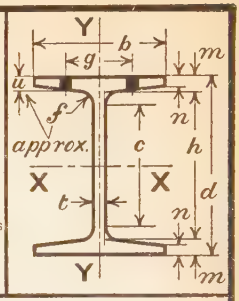
# 8" CM

## CARNEGIE MILL SECTIONS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



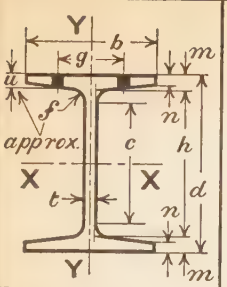

| | | | |
|---|---|---|---|
| Depth = d". | | 8.00 | 8.00 |
| Wt. per foot. | | 17.5 | 21.0 |
| Area Sq. In.. | | 5 14 | 6.17 |
| b" ..... | | 4.981 | 5.110 |
| t..... | | .231 | .360 |
| h ..... | | 7.108 | 7.108 |
| m..... | | .446 | .446 |
| n ..... | | .238 | .238 |
| f..... | | .25 | .25 |
| c..... | | 6⅝ | 6⅝ |
| g. .... | | 2¼ | 2¼ |
| u ..... | | ⅜ | ⅜ |
| AXES X-X | I. .. | 57.4 | 63.4 |
| | S.... | 14.35 | 15.85 |
| | r.... | 3 36 | 3.21 |
| AXES Y-Y | I.... | 6.0 | 6.6 |
| | S ... | 2.4 | 2.6 |
| | r.... | 1.08 | 1.03 |
| Coef. Str.... | | 172200 | 190200 |
| Max.Mom."# | | 258300 | 285300 |
| V ..... | | 22180 | 34560 |
| P. feet.. | | 3 88 | 2 76 |
| R..... | | 19060 | 29700 |
| W..... | | 20800 | 23860 |
| Q. feet.. | | 4 14 | 3.99 |
| w. lbs... | | 13 | 13 |
| Rivet dia .. | | ¾ | ¾ |

Live Load deflection must not exceed 1/360 of the Span.

Live Load Def. = $\frac{\text{Total Def.} \times \text{Live Load}}{\text{Tabular Load}}$

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|
| 3 | 44.4 | 44.4 | 63.4 | 63.4 | |
| 4 | 42.9 | 42.9 | 47.6 | 47.6 | .037 |
| 5 | 34 3 | 34.3 | 38.1 | 38.1 | .058 |
| 6 | 28.6 | 28.6 | 31.7 | 31.7 | .084 |
| 7 | 24.5 | 23 9 | 27.2 | 26.6 | .114 |
| 8 | 21.5 | 20 1 | 23.8 | 22.5 | .149 |
| 9 | 19 1 | 17.1 | 21.1 | 19.2 | .189 |
| 10 | 17.2 | 14.8 | 19.0 | 16.6 | .233 |
| 11 | 15 6 | 12.8 | 17 3 | 14.4 | .281 |
| 12 | 14 3 | 11 2 | 15.9 | 12.6 | .335 |
| 13 | 13.2 | 9 9 | 14 6 | 11.1 | .394 |
| 14 | 12.3 | 8 7 | 13.6 | 9.8 | .456 |
| 15 | 11.4 | | 12.7 | .... | .524 |
| 16 | 10 7 | | 11 9 | .... | .596 |
| 17 | 10 1 | | 11.2 | .... | .674 |
| 18 | 9 6 | | 10 6 | .... | .754 |
| 19 | 9.1 | | 10.0 | .... | .840 |
| 20 | 8.6 | | 9.5 | .... | .931 |




# CARNEGIE MILL SECTIONS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets
Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.

# 9″ CM

| | | | | |
|---|---|---|---|---|
| Depth = d″. | | 9.00 | 9.00 | Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load |
| Wt. per foot. | | 20.5 | 25.0 | |
| Area Sq. In.. | | 6.02 | 7.34 | |
| b″ ..... | | 5.234 | 5.380 | |
| t..... | | .234 | .380 | |
| h ..... | | 8.008 | 8.008 | |
| m..... | | .496 | .496 | |
| n ..... | | .277 | .277 | |
| f..... | | .275 | .275 | |
| c..... | | 7½ | 7½ | |
| g..... | | 2½ | 2½ | |
| u ..... | | 13/32 | 13/32 | |
| AXES | X-X I.... | 86.6 | 95.5 | |
| | X-X S ... | 19.24 | 21.22 | |
| | X-X r.... | 3.79 | 3.61 | |
| | Y-Y I.... | 8.0 | 8.8 | |
| | Y-Y S ... | 3.1 | 3.3 | |
| | Y-Y r.... | 1.15 | 1.09 | |
| Coef. Str .... | | 230930 | 254670 | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
| Max.Mom.″# | | 346400 | 382000 | |
| V ..... | | 25270 | 41040 | |
| P. feet .. | | 4.57 | 3.10 | |
| R..... | | 19430 | 32770 | |
| W..... | | 21060 | 23860 | |
| Q. feet .. | | 5.48 | 5.34 | |
| w. lbs... | | 13 | 13 | |
| Rivet dia.... | | ¾ | ¾ | |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | |
|---|---|---|---|---|---|
| 3 | 50.5 | 50.5 | 82.1 | 82.1 | |
| 4 | 50.5 | 50.5 | 63.7 | 63.7 | |
| 5 | 46.1 | 46.1 | 50.9 | 50.9 | .052 |
| 6 | 38.4 | 38.4 | 42.4 | 42.4 | .074 |
| 7 | 32.9 | 32.4 | 36.4 | 36.1 | .101 |
| 8 | 28.8 | 27.4 | 31.8 | 30.6 | .132 |
| 9 | 25.6 | 23.4 | 28.3 | 26.2 | .168 |
| 10 | 23.1 | 20.2 | 25.5 | 22.7 | .207 |
| 11 | 20.9 | 17.6 | 23.1 | 19.8 | .250 |
| 12 | 19.2 | 15.5 | 21.2 | 17.4 | .298 |
| 13 | 17.7 | 13.7 | 19.6 | 15.3 | .350 |
| 14 | 16.5 | 12.1 | 18.2 | 13.6 | .406 |
| 15 | 15.4 | 10.7 | 17.0 | 12.1 | .466 |
| 16 | 14.4 | 9.6 | 15.9 | 10.8 | .530 |
| 17 | 13.6 | | 15.0 | .... | .599 |
| 18 | 12.8 | | 14.1 | .... | .670 |
| 19 | 12.1 | | 13.4 | .... | .747 |
| 20 | 11.5 | | 12.7 | .... | .828 |

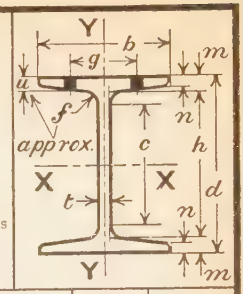
# 4" TO 8"

## CARNEGIE H BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½" bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| Depth = d" | | | 4" | 5" | 6" | 6" | 6" | 6" | 8" | 8" | 8" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Weight per foot | | | 13 8 | 18 9 | 20 0 | 22 5 | 25.0 | 27.5 | 32 6 | 34 3 | 37.7 |
| Area Sq In. | | | 3 99 | 5 47 | 5 86 | 6 61 | 7 33 | 8 08 | 9.50 | 10 00 | 11.00 |
| b" | | | 4 000 | 5 000 | 5.938 | 6 063 | 5 938 | 6.063 | 7.938 | 8 000 | 8.125 |
| t | | | .313 | 313 | .250 | 375 | .313 | .438 | 313 | .375 | .500 |
| h | | | 3.094 | 3 994 | 5 042 | 5 042 | 4.849 | 4 849 | 6 880 | 6 880 | 6.880 |
| m | | | .453 | .503 | .479 | .479 | .580 | .580 | .560 | .560 | .560 |
| n | | | .290 | .330 | .280 | .280 | .381 | .381 | .358 | .358 | .358 |
| f | | | 313 | 313 | .313 | .313 | .313 | .313 | .313 | .313 | .313 |
| c | | | 2 522 | 3 413 | 4 458 | 4 458 | 4.256 | 4 256 | 6 287 | 6 287 | 6.287 |
| g | | | 2¼ | 2¾ | 3½ | 3½ | 3½ | 3½ | 4" | 4" | 4" |
| u | | | 3/8 | 7/16 | 3/8 | 3/8 | ½ | ½ | ½ | ½ | ½ |
| AXES | X-X | I | 10 7 | 23 8 | 38 8 | 41.0 | 47.0 | 49.3 | 112 8 | 115 5 | 120.8 |
| | | S | 5.35 | 9 52 | 12 93 | 13 67 | 15.67 | 16 43 | 28.20 | 28.88 | 30.20 |
| | | r | 1.64 | 2 08 | 2 57 | 2 19 | 2 53 | 2 47 | 3.45 | 3 40 | 3.31 |
| | Y-Y | I | 3 6 | 7.8 | 11.4 | 12.2 | 14.9 | 16 0 | 34.2 | 35.1 | 36.9 |
| | | S | 1 8 | 3 1 | 3 8 | 4 0 | 5 0 | 5 3 | 8.6 | 8.8 | 9.1 |
| | | r | 0 95 | 1.20 | 1 39 | 1.36 | 1.43 | 1 41 | 1 90 | 1.87 | 1.83 |
| Coef Str | | | 64200 | 114240 | 155160 | 164040 | 188040 | 197160 | 338400 | 346560 | 362400 |
| Max Mom."# | | | 96300 | 173160 | 232740 | 246060 | 282060 | 295740 | 507600 | 519840 | 543600 |
| V | | | 15020 | 18780 | 18000 | 27000 | 22540 | 31540 | 30050 | 36000 | 48000 |
| P. feet | | | 2.14 | 3.04 | 4.31 | 3.04 | 4.17 | 3.13 | 5.63 | 4 81 | 3.78 |
| R | | | 21130 | 22300 | 18750 | 28130 | 23480 | 32850 | 25820 | 30940 | 41250 |
| W | | | 11930 | 11930 | 11250 | 11930 | 11930 | 11930 | 23860 | 23860 | 23860 |
| Q. feet | | | 2.69 | 4.79 | 6.90 | 6.88 | 7.88 | 8.26 | 7.09 | 7.26 | 7.59 |
| w. lbs | | | 6 | 6 | 6 | 6 | 6 | 6 | 13 | 13 | 13 |
| Rivet dia. | | | 5/8 | 5/8 | ¾ | ¾ | ¾ | ¾ | ¾ | ¾ | ¾ |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 21 2 | 21 2 | 37.6 | 37 6 | 36.0 | 36 0 | 54 0 | 54.0 | 45 1 | 45 1 | 63.1 | 63.1 | 60.1 | 60.1 | 72.0 | 72.0 | 96.0 | 96.0 |
| 4 | 15 9 | 15 9 | 28.5 | 28 5 | 36.0 | 36 0 | 41 0 | 41 0 | 45.1 | 45.1 | 49.3 | 49.3 | 60.1 | 60.1 | 72.0 | 72.0 | 90.6 | 90.6 |
| 5 | 12 7 | 12.7 | 22 8 | 22 8 | 31.0 | 31.0 | 32 8 | 32 8 | 37.6 | 37.6 | 39.4 | 39.4 | 60.1 | 60.1 | 69.4 | 69.4 | 72.5 | 72.5 |
| 6 | 10 6 | 10 1 | 19 0 | 19 0 | 25.9 | 25 9 | 27 4 | 27.4 | 31.4 | 31.4 | 32 9 | 32.9 | 56 4 | 56.4 | 57.8 | 57.8 | 60.4 | 60.4 |
| 7 | 9 1 | 8.3 | 16 3 | 15 9 | 22.2 | 22 2 | 23 4 | 23 4 | 26 9 | 26.9 | 28.2 | 28.2 | 48 3 | 48.3 | 49.5 | 49.5 | 51.8 | 51.8 |
| 8 | 8 0 | ... | 14 3 | 13.4 | 19.4 | 19 0 | 20 5 | 20 3 | 23 5 | 23.1 | 24 6 | 24 4 | 42 3 | 42.3 | 43.4 | 43.4 | 45.3 | 45.3 |
| 9 | 7 1 | ... | 12 7 | .. | 17.2 | 16 4 | 18.2 | 17 5 | 20 9 | 19.9 | 21.9 | 21.0 | 37.6 | 37.6 | 38 5 | 38.5 | 40.3 | 40.3 |
| 10 | 6 4 | .. | 11 4 | .. | 15.5 | 14.3 | 16 4 | 15.3 | 18 8 | 17.3 | 19 7 | 18.3 | 33.8 | 33.8 | 34.7 | 34.7 | 36.2 | 36.2 |
| 11 | 5 8 | .. | 10 4 | ... | 14.1 | ... | 14 9 | . | 17 1 | ... | 17 9 | ... | 30 8 | 30 0 | 31.5 | 30.8 | 32.9 | 32.3 |
| 12 | 5 4 | . | 9 5 | ... | 12 9 | ... | 13 7 | . | 15 7 | ... | 16 4 | ... | 28 2 | 26 9 | 28.9 | 27.6 | 30.2 | 29.0 |
| 13 | . | ... | 8 9 | ... | 11 9 | ... | 12 6 | . | 14 5 | ... | 15 2 | ... | 26 0 | 24.2 | 26.7 | 24.9 | 27.9 | 26.1 |
| 14 | . | ... | 8 2 | ... | 11 1 | ... | 11 7 | . | 13 4 | ... | 14.1 | . | 24 2 | 21.9 | 24 8 | 22.6 | 25.9 | 23.7 |
| 15 | .. | .. | . | . | 10 3 | .. | 10 9 | . | 12 5 | ... | 13.1 | .... | 22.6 | .... | 23.1 | .... | 24.2 | .... |
| 16 | .. | .. | . | . | .... | .. | .... | .. | .. | .... | .... | .... | 21.2 | .... | 21.7 | .... | 22.7 | .... |
| 17 | .. | .. | . | . | .... | .. | .... | .. | .. | .... | .... | .... | 19.9 | .... | 20 4 | .... | 21.3 | .... |

Total Deflection in inches for Maximum Load; Laterally fixed beam

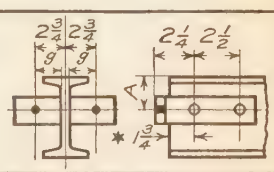
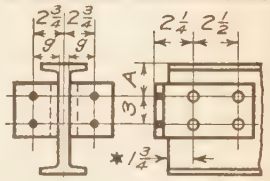
Live Load deflection must not exceed 1/360 of the Span.

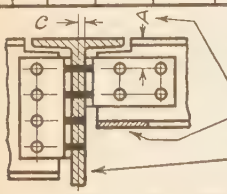
Live Load Def. = (Total Def × Live Load) / Tabular Load

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | .042 | | . . | | . | .... | .... | .... | .... | .... | .... |
| 4 | .074 | .059 | | | .050 | . . | .050 | .... | .... | .... | .037 |
| 5 | .116 | .093 | .078 | | .078 | .078 | .078 | . . | .058 | | .058 |
| 6 | .168 | .134 | .112 | | .112 | .112 | .112 | .084 | .084 | | .084 |
| 7 | .228 | .182 | .152 | | .152 | .152 | .152 | .114 | .114 | | .114 |
| 8 | .298 | .238 | .198 | | .198 | .198 | .198 | .149 | .149 | | .149 |
| 9 | .378 | .302 | .252 | | .252 | .252 | .252 | .189 | .189 | | .189 |
| 10 | .465 | .372 | .310 | | .310 | .310 | .310 | .233 | .233 | | .233 |
| 11 | .562 | .450 | .375 | | .375 | .375 | .375 | .281 | .281 | | .281 |
| 12 | .670 | .537 | .447 | | .447 | .447 | .447 | .335 | .335 | | .335 |
| 13 | .... | .630 | .525 | | .525 | .525 | .525 | .394 | .394 | | .394 |
| 14 | .... | .730 | .608 | | .608 | .608 | .608 | .456 | .456 | | .456 |
| 15 | . . | .. | .698 | | .698 | .698 | .698 | .524 | .524 | | .524 |
| 16 | .... | .... | .... | | .... | .... | .... | .596 | .596 | | .596 |
| 17 | .... | .... | .... | | .... | .... | .... | .674 | .674 | | .674 |

# CONNECTION ANGLES FOR CARNEGIE MILL SECTIONS AND H BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

| Beam Type | Depth | Weight per foot | Connection Value: Outstanding Leg, Single Shear, Web | Connection Value: Outstanding Leg, Single Shear, Power Driven Rivets | Connection Value: Outstanding Leg, Single Shear, Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Weight inc Web Rivets | Connection Details |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H Beams | 4 | 13.8 | 14090 | 11930 | 8840 | 1/4 | 1C. 6. 9 | 2 9/16 | 6" × 4" × 3/8" 0' — 2 1/2" Long | 6 lbs. |  |
| H Beams | 5 | 18.9 | 14090 | 11930 | 8840 | 1/4 | 1C. 6. 9 | 2 9/16 | | | |
| H Beams | 6 | 20.0 | 11250 | 11930 | 8840 | 3/16 | 1C. 6.10 | 2 5/8 | | | |
| H Beams | 6 | 22.5 | 16880 | 11930 | 8840 | 1/4 | 1C. 6. 9 | 2 9/16 | | | |
| H Beams | 6 | 25 0 | 14090 | 11930 | 8840 | 1/4 | 1C. 6. 9 | 2 9/16 | | | |
| H Beams | 6 | 27.5 | 19710 | 11930 | 8840 | 5/16 | 1C. 6. 8 | 2 1/2 | | | |
| H Beams | 8 | 32.6 | 28170 | 23860 | 17670 | 1/4 | 1C.13. 9 | 2 9/16 | 6" × 4" × 3/8" 0' — 5 1/2" Long | 13 lbs. |  |
| H Beams | 8 | 34.3 | 33750 | 23860 | 17670 | 1/4 | 1C.13. 9 | 2 9/16 | | | |
| H Beams | 8 | 37.7 | 45000 | 23860 | 17670 | 5/16 | 1C.13. 8 | 2 1/2 | | | |
| Mill Sections | 8 | 17.5 | 20800 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| Mill Sections | 8 | 21.0 | 32400 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |
| Mill Sections | 9 | 20.5 | 21100 | 23860 | 17670 | 3/16 | IC.13.10 | 2 5/8 | | | |
| Mill Sections | 9 | 25.0 | 34200 | 23860 | 17670 | 1/4 | IC.13. 9 | 2 9/16 | | | |




*Layer-out starts with this dimension at left end of beam. With beams ordered one inch short, as usual in standard shop practice, this leaves sufficient end distance or clearance at right end, in case of full allowable 3/8" underrun or 3/8" overrun in beam lengths.

When A = 3" all beams except 4" H, can be framed opposite with tops flush.

Flange must be cut away as shown for field riveting on all beams framing opposite a larger beam, if flange interferes with outstanding rivets.

Minimum Web required to develop Single Shearing Value is .33".
Minimum Web required to develop Double Shearing Value is .53".

# ALLOWABLE END REACTIONS FOR CARNEGIE MILL SECTIONS AND H BEAMS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Type | Depth | Weight per foot | Web t | Unit Stress in Buckling | Reaction R for 3 1/2" Bearing | Min. Span for 3 1/2" Bearing | Reaction R for 5 1/2" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|---|
| H Beams | 4 | 13.8 | .313 | 15000 | 21130 | 1.52 | 30520 | 4700 | 15020 | 2.20 |
| H Beams | 5 | 18.9 | .313 | 15000 | 22300 | 2.56 | 31690 | 4700 | 18780 | 2.75 |
| H Beams | 6 | 20.0 | .250 | 15000 | 18750 | 4.14 | 26250 | 3750 | 18000 | 3.30 |
| H Beams | 6 | 22.5 | .375 | 15000 | 28130 | 2 92 | 39380 | 5630 | 27000 | 3 30 |
| H Beams | 6 | 25.0 | .313 | 15000 | 23480 | 4 00 | 32870 | 4700 | 22540 | 3.30 |
| H Beams | 6 | 27.5 | .438 | 15000 | 32850 | 3.00 | 45990 | 6570 | 31540 | 3.30 |
| H Beams | 8 | 32.6 | .313 | 15000 | 25820 | 6.55 | 35210 | 4700 | 30050 | 4.40 |
| H Beams | 8 | 34 3 | .375 | 15000 | 30940 | 5.60 | 42190 | 5630 | 36000 | 4 40 |
| H Beams | 8 | 37.7 | .500 | 15000 | 41250 | 4.39 | 56250 | 7500 | 48000 | 4.40 |
| Mill Sects. | 8 | 17.5 | .231 | 15000 | 19060 | 4.52 | 25990 | 3470 | 22180 | 4 40 |
| Mill Sects. | 8 | 21.0 | .360 | 15000 | 29700 | 3.99 | 40500 | 5400 | 34560 | 4.40 |
| Mill Sects. | 9 | 20.5 | .234 | 14400 | 19430 | 5.94 | 26180 | 3380 | 25270 | 5 23 |
| Mill Sects. | 9 | 25.0 | .380 | 15000 | 32770 | 5.34 | 44170 | 5700 | 41040 | 4.95 |

The beam web is treated as a column with fixed ends, having an effective length $l$ of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

**6″ TO 12″**

**J**

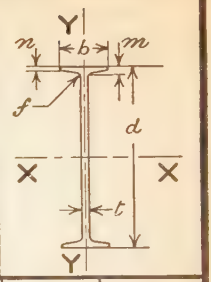
# J AND L JUNIOR BEAMS

## ROLLED FROM COPPER BEARING STEEL

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia S is Section Modulus r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 2½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | | 6″ | 7″ | 8″ | 9″ | 10″ | 11″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| Depth = d″ | | | 6.028 | 7.028 | 8.028 | 9.018 | 10.026 | 11.024 | 12.028 |
| Weight per foot | | | 4.41 | 5.48 | 6.54 | 7.48 | 8.96 | 10.23 | 11.74 |
| Area Sq. In. | | | 1.30 | 1.61 | 1.92 | 2.20 | 2.64 | 3.01 | 3.45 |
| b″ | | | 1.84 | 2.08 | 2.28 | 2.38 | 2.69 | 2.84 | 3.06 |
| t″ | | | .114 | .126 | .135 | .145 | .155 | .165 | .175 |
| m | | | .200 | .212 | .224 | .231 | .247 | .258 | .272 |
| n | | | .142 | .148 | .154 | .155 | .165 | .170 | .178 |
| f | | | .150 | .165 | .180 | 195 | .210 | .225 | .240 |
| AXES | X-X | I | 7.30 | 12.13 | 18.67 | 26.20 | 39.01 | 53.08 | 72.21 |
| | | S | 2.42 | 3.45 | 4.65 | 5.81 | 7.78 | 9.63 | 12.01 |
| | | r | 2.372 | 2.744 | 3.116 | 3.450 | 3.847 | 4.200 | 4.573 |
| | Y-Y | I | .1654 | .2482 | .3434 | .3939 | .6078 | .7459 | .9776 |
| | | S | .1794 | .2389 | .3011 | .3317 | .4523 | .5246 | .6385 |
| | | r | .3569 | .3925 | .4226 | .4230 | .4802 | .4979 | .5320 |
| Coef. Str. | | | 29074 | 41425 | 55817 | 69727 | 93369 | 115555 | 144088 |
| Max. Mom.″# | | | 43610 | 62137 | 83726 | 104591 | 140054 | 173332 | 216131 |
| V | | | 8210 | 10580 | 12960 | 15660 | 18330 | 20930 | 23700 |
| P. feet. | | | 1.77 | 1.96 | 2.15 | 2.23 | 2.55 | 2.76 | 3.04 |
| R. | | | 5620 | 6370 | 6900 | 7550 | 8240 | 8960 | 9710 |
| W. | | | 5130 | 5670 | 6075 | 6525 | 6975 | 7425 | 7875 |
| Q. feet | | | 2.83 | 3.65 | 4.59 | 5.34 | 6.69 | 7.78 | 9.15 |
| w. lbs | | | 4 | 5 | 5 | 5 | 5 | 5 | 5 |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

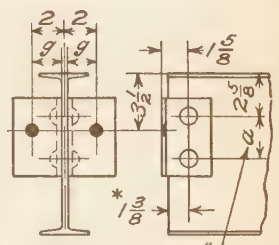
| Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Laterally fixed | Laterally free |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 4.85 | 3.05 | 6.90 | 4.80 | 9.30 | 6.90 | 11.62 | 8.86 | 15.56 | 12.73 | 19.26 | 16.20 | 24.02 | 20.90 |
| 7 | 4.15 | .... | 5.92 | .... | 7.97 | 5.28 | 9.96 | 6.82 | 13.34 | 9.96 | 16.51 | 12.76 | 20.58 | 16.61 |
| 8 | 3.63 | .... | 5.18 | .... | 6.98 | .... | 8.72 | 5.34 | 11.67 | 7.92 | 14.44 | 10.21 | 18.01 | 13.41 |
| 9 | 3.23 | .... | 4.60 | .... | 6.20 | .... | 7.75 | .... | 10.37 | .... | 12.84 | 8.28 | 16.01 | 10.96 |
| 10 | 2.91 | .... | 4.14 | .... | 5.58 | .... | 6.97 | .... | 9.34 | .... | 11.56 | .... | 14.41 | .... |
| 11 | 2.64 | .... | 3.77 | .... | 5.07 | .... | 6.34 | .... | 8.49 | .... | 10.51 | .... | 13.10 | .... |
| 12 | 2.42 | .... | 3.45 | .... | 4.65 | .... | 5.81 | .... | 7.78 | .... | 9.63 | .... | 12.01 | .... |
| 13 | 2.24 | .... | 3.19 | .... | 4.29 | .... | 5.36 | .... | 7.18 | .... | 8.89 | .... | 11.08 | .... |
| 14 | 2.08 | .... | 2.96 | .... | 3.99 | .... | 4.98 | .... | 6.67 | .... | 8.25 | .... | 10.29 | .... |
| 15 | 1.94 | .... | 2.76 | .... | 3.72 | .... | 4.65 | .... | 6.23 | .... | 7.70 | .... | 9.61 | .... |
| 16 | 1.82 | .... | 2.59 | .... | 3.49 | .... | 4.36 | .... | 5.84 | .... | 7.22 | .... | 9.01 | .... |
| 17 | 1.71 | .... | 2.44 | .... | 3.28 | .... | 4.10 | .... | 5.49 | .... | 6.80 | .... | 8.48 | .... |
| 18 | 1.62 | .... | 2.30 | .... | 3.10 | .... | 3.87 | .... | 5.19 | .... | 6.42 | .... | 8.01 | .... |
| 19 | 1.53 | .... | 2.18 | .... | 2.94 | .... | 3.67 | .... | 4.91 | .... | 6.08 | .... | 7.58 | .... |
| 20 | 1.45 | .... | 2.07 | .... | 2.79 | .... | 3.49 | .... | 4.67 | .... | 5.78 | .... | 7.20 | .... |
| 21 | 1.38 | .... | 1.97 | .... | 2.66 | .... | 3.32 | .... | 4.45 | .... | 5.50 | .... | 6.86 | .... |
| 22 | 1.32 | .... | 1.88 | .... | 2.54 | .... | 3.17 | .... | 4.24 | .... | 5.25 | .... | 6.55 | .... |
| 23 | 1.26 | .... | 1.80 | .... | 2.43 | .... | 3.03 | .... | 4.06 | .... | 5.02 | .... | 6.27 | .... |
| 24 | 1.21 | .... | 1.73 | .... | 2.33 | .... | 2.91 | .... | 3.89 | .... | 4.82 | .... | 6.00 | .... |
| 25 | 1.16 | .... | 1.66 | .... | 2.23 | .... | 2.79 | .... | 3.74 | .... | 4.62 | .... | 5.76 | .... |
| 26 | 1.12 | .... | 1.59 | .... | 2.15 | .... | 2.68 | .... | 3.59 | .... | 4.44 | .... | 5.54 | .... |

Total Deflection in inches for Maximum Load; Laterally fixed beam. Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | .252 | .216 | .189 | .168 | .151 | .137 | .126 |
| 10 | .310 | .266 | .233 | .207 | .186 | .169 | .155 |
| 11 | .375 | .321 | .281 | .250 | .225 | .205 | .188 |
| 12 | .447 | .383 | .335 | 298 | .268 | .244 | .223 |
| 13 | .525 | .450 | .394 | .350 | .315 | .286 | .263 |
| 14 | .608 | .521 | .456 | .406 | .365 | .332 | .304 |
| 15 | .698 | .599 | .524 | .466 | .419 | .381 | .341 |
| 16 | .795 | .681 | .596 | .530 | .477 | .434 | .398 |
| 17 | .898 | .770 | .674 | .599 | .539 | .490 | .449 |
| 18 | 1.01 | .861 | .754 | .670 | .603 | .548 | .503 |
| 19 | 1.12 | .960 | .840 | .747 | .672 | .611 | .560 |
| 20 | 1.24 | 1.06 | .931 | .828 | .745 | .677 | .621 |
| 21 | 1.37 | 1.17 | 1.03 | .912 | .821 | .746 | .684 |
| 22 | 1.51 | 1.29 | 1.13 | 1.00 | .901 | .819 | .751 |
| 24 | 1.79 | 1.53 | 1.34 | 1.19 | 1.07 | .975 | .894 |
| 26 | 2.10 | 1.80 | 1.57 | 1.40 | 1.26 | 1.14 | 1.05 |

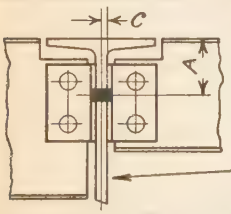
# CONNECTION ANGLES FOR J AND L JUNIOR BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS — ¾″ POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value: Outstanding Single Shear Web | Connection Value: Outstanding Single Shear Power Driven Rivets | Connection Value: Outstanding Single Shear Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Connection Angles: Weight inc. Web Rivets | Connection Details |
|---|---|---|---|---|---|---|---|---|---|---|
| 6″ | 4.41 | 5130 | 9000 | 6000 | ⅛ | IC. 4.15 | 1 15/16 | 3 x 3 x ¼ 4¼″ Long | 4 lbs. |  |
| 7″ | 5.48 | 5670 | 9000 | 6000 | ⅛ | IC. 5.15 | 1 15/16 | | | |
| 8″ | 6.54 | 6075 | 9000 | 6000 | ⅛ | IC. 5.15 | 1 15/16 | | | |
| 9″ | 7.48 | 6525 | 9000 | 6000 | ⅛ | IC. 5.15 | 1 15/16 | 3 x 3 x ¼ 4⅞″ Long | 5 lbs. | |
| 10″ | 8.96 | 6975 | 9000 | 6000 | ⅛ | IC. 5.15 | 1 15/16 | | | |
| 11″ | 10.23 | 7425 | 9000 | 6000 | ⅛ | IC. 5.15 | 1 15/16 | | | |
| 12″ | 11.74 | 7875 | 9000 | 6000 | ⅛ | IC. 5.15 | 1 15/16 | | | |



For IC. 4.15:- a = 2″
For IC. 5.15:- a = 2 5/8″




*Layer-out starts with this dimension at left end of beam. With beams ordered one half inch short, as recommended for J & L Junior beams, this leaves sufficient end distance at right end, in case of full allowable ⅜″ underrun in beam lengths.

When A = 3½″ all Junior beams can be framed opposite with tops flush.

Minimum Web required to develop Single Shearing Value is .33″
Minimum Web required to develop Double Shearing Value is .53″

# ALLOWABLE END REACTIONS FOR J AND L JUNIOR BEAMS

DETERMINED BY

## BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 2½″ Bearing | Min. Span for 2½″ Bearing | Reaction R for 3½″ Bearing | Increase in R for 1″ Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 6″ | 4.41 | .114 | 12310 | 5620 | 2.59 | 7020 | 1400 | 8210 | 4.35 |
| 7″ | 5.48 | .126 | 11890 | 6370 | 3.25 | 7860 | 1500 | 10580 | 5.32 |
| 8″ | 6.54 | .135 | 11360 | 6900 | 4.05 | 8430 | 1530 | 12960 | 6.45 |
| 9″ | 7.48 | .145 | 10960 | 7550 | 4.62 | 9140 | 1590 | 15660 | 7.60 |
| 10″ | 8.96 | .155 | 10630 | 8240 | 5.67 | 9880 | 1650 | 18330 | 8.63 |
| 11″ | 10.23 | .165 | 10340 | 8960 | 6.45 | 10660 | 1710 | 20930 | 9.52 |
| 12″ | 11.74 | .175 | 10090 | 9710 | 7.42 | 11480 | 1770 | 23700 | 10.42 |

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.
When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

**6″ TO 12″**

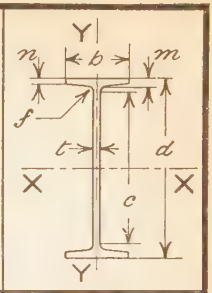
# BJ

## BETHLEHEM STEEL JOISTS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 2½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




| | | 6″ | 8″ | | 10″ | | 12″ | |
|---|---|---|---|---|---|---|---|---|
| Depth—d″ | | 6 00 | 8 00 | 8 12 | 10 00 | 10 16 | 12 00 | 12 16 |
| Weight per foot | | 11 0 | 14 5 | 16 0 | 16 5 | 19 0 | 18 5 | 21 0 |
| Area, Sq. In. | | 3 25 | 4 28 | 4 74 | 4 86 | 5 60 | 5 44 | 6 22 |
| b″ | | 3 33 | 3 875 | 3 875 | 4 000 | 4 010 | 4 125 | 4 135 |
| t″ | | 230 | 240 | 240 | 240 | 250 | 240 | 250 |
| m | | 359 | 391 | 451 | 397 | 477 | 402 | 482 |
| n | | 230 | 240 | 300 | 240 | 320 | 240 | 320 |
| f | | 25 | 30 | 30 | 30 | 30 | 30 | 30 |
| c | | 4 82 | 6 67 | 6 67 | 8 65 | 8 65 | 10 64 | 10 64 |
| AXES X-X | I | 19 3 | 44 9 | 52 4 | 77 4 | 94 5 | 121 5 | 147 0 |
| | S | 6 43 | 11 23 | 12 91 | 15 48 | 18 60 | 20 25 | 24 18 |
| | r | 2 44 | 3 24 | 3 32 | 3 99 | 4 11 | 4 73 | 4 86 |
| AXES Y-Y | I | 1 64 | 2 73 | 3 31 | 3 02 | 3 90 | 3 33 | 4 30 |
| | S | 98 | 1 41 | 1 71 | 1 51 | 1 95 | 1 61 | 2 08 |
| | r | 71 | 80 | 84 | 79 | 83 | 78 | 83 |
| Coef Str | | 77200 | 134700 | 154880 | 185760 | 223230 | 243000 | 290130 |
| Max Mom. ″# | | 115800 | 202050 | 232320 | 278640 | 334840 | 364500 | 435200 |
| V | | 16560 | 23040 | 23390 | 28800 | 30480 | 34560 | 36480 |
| P. feet | | 2.33 | 2.92 | 3.31 | 3.23 | 3.66 | 3.52 | 3.98 |
| R | | 13800 | 16200 | 16300 | 16750 | 17790 | 16770 | 17890 |
| W | | 10360 | 10800 | 10800 | 10800 | 11260 | 10800 | 11260 |
| Q feet | | 3 72 | 6 24 | 7 17 | 8 6 | 9 91 | 11 25 | 12 88 |
| w. lbs. | | 6 | 9 | 9 | 9 | 9 | 9 | 9 |

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least.
For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | 6″ Laterally fixed | 6″ Laterally free | 8″ Laterally fixed | 8″ Laterally free | 8″ Laterally fixed | 8″ Laterally free | 10″ Laterally fixed | 10″ Laterally free | 10″ Laterally fixed | 10″ Laterally free | 12″ Laterally fixed | 12″ Laterally free | 12″ Laterally fixed | 12″ Laterally free |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 12 86 | 11 58 | 22 45 | 20 92 | 25 81 | 24 15 | 30 96 | 29 60 | 37 21 | 35 60 | 40 50 | 39 05 | 48 36 | 46 66 |
| 7 | 11 03 | 9 29 | 19 24 | 17 31 | 22 13 | 19 91 | 26 54 | 24 16 | 31 89 | 29 05 | 34 71 | 31 94 | 41 45 | 38 18 |
| 8 | 9 65 | 7 58 | 16 84 | 14 31 | 19 36 | 16 46 | 23 22 | 20 03 | 27 90 | 24 09 | 30 38 | 26 56 | 36 27 | 31 75 |
| 9 | 8 57 | 6 24 | 14 97 | 11 98 | 17 21 | 13 77 | 20 64 | 16 81 | 24 80 | 20 22 | 27 00 | 22 34 | 32 24 | 26 71 |
| 10 | 7 72 | 5 20 | 13 47 | 10 12 | 15 49 | 11 63 | 18 58 | 14 24 | 22 32 | 17 13 | 24 30 | 18 97 | 29 01 | 22 68 |
| 11 | 7 01 | 4.36 | 12 25 | 8 61 | 14 08 | 9 90 | 16 89 | 12 15 | 20 29 | 14 62 | 22 09 | 16 23 | 26 38 | 19 42 |
| 12 | 6 43 | | 11 22 | 7 37 | 12 91 | 8 49 | 15 48 | 10 44 | 18 60 | 12 57 | 20 25 | 13.98 | 24 18 | 16 73 |
| 13 | 5 94 | | 10 36 | | 11 91 | | 14 29 | 9 02 | 17 17 | 10 86 | 18 69 | 12 11 | 22 32 | 14 49 |
| 14 | 5 51 | | 9 62 | | 11 06 | | 13 27 | | 15 95 | | 17 36 | | 20 72 | |
| 15 | 5 14 | | 8 98 | | 10 33 | | 12 38 | | 14 88 | | 16 20 | | 19 34 | |
| 16 | 4 83 | | 8 42 | | 9 68 | | 11 61 | | 13 95 | | 15 19 | | 18 13 | |
| 17 | 4 54 | | 7 92 | | 9 11 | | 10 93 | | 13 13 | | 14 29 | | 17 07 | |
| 18 | 4 29 | | 7 48 | | 8 60 | | 10 32 | | 12 40 | | 13 50 | | 16 12 | |
| 19 | 4 06 | | 7 09 | | 8 15 | | 9 78 | | 11 75 | | 12 79 | | 15 27 | |
| 20 | 3 86 | | 6 74 | | 7 74 | | 9 29 | | 11 16 | | 12 15 | | 14 51 | |
| 22 | 3 51 | | 6 12 | | 7 04 | | 8 44 | | 10 15 | | 11 05 | | 13 19 | |
| 24 | 3 22 | | 5 61 | | 6 45 | | 7 74 | | 9 30 | | 10 13 | | 12 09 | |
| 26 | 2 97 | | 5 18 | | 5 96 | | 7 14 | | 8 59 | | 9 35 | | 11 16 | |

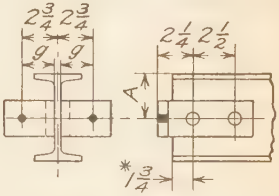
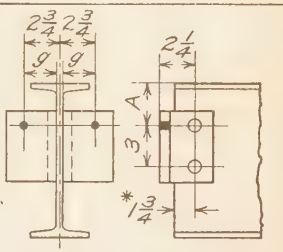
Total Deflection in inches for Maximum Load; Laterally fixed beam.
Live Load deflection must not exceed 1/360 of the Span.
Live Load Def. = Total Def. × Live Load / Tabular Load

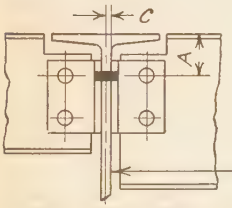
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6 | .112 | .084 | .084 | .067 | .067 | .056 | .056 | |
| 7 | .152 | .114 | .114 | .091 | .091 | .076 | .076 | |
| 8 | .198 | .149 | .149 | .119 | .119 | .099 | .099 | |
| 9 | .252 | .189 | .188 | .151 | .151 | .126 | .126 | |
| 10 | .310 | .233 | .233 | .186 | .186 | .155 | .155 | |
| 11 | .375 | .281 | .281 | .225 | .225 | .188 | .188 | |
| 12 | .447 | .335 | .335 | .268 | .268 | .223 | .223 | |
| 13 | .525 | .394 | .394 | .315 | .315 | .263 | .263 | |
| 14 | .608 | .456 | .456 | .365 | .365 | .304 | .304 | |
| 15 | .698 | .524 | .524 | .419 | .419 | .341 | .341 | |
| 16 | .795 | .596 | .596 | .477 | .477 | .398 | .398 | |
| 17 | .898 | .674 | .674 | .539 | .539 | .449 | .449 | |
| 18 | 1 01 | .754 | .754 | .603 | .603 | .503 | .503 | |
| 19 | 1 12 | .840 | .840 | .672 | .672 | .560 | .560 | |
| 20 | 1 24 | .931 | .931 | .745 | .745 | .621 | .621 | |
| 22 | 1 51 | 1 13 | 1.13 | .901 | .901 | .751 | .751 | |
| 24 | 1 79 | 1 34 | 1 34 | 1.07 | 1.07 | .894 | .894 | |
| 26 | 2 10 | 1 57 | 1 57 | 1.26 | 1.26 | 1.05 | 1 05 | |

LOADS BY A. I. S. C. SPECIFICATION

# CONNECTION ANGLES FOR BETHLEHEM STEEL JOISTS

DIMENSIONS, WEIGHTS, AND WORKING LOADS — 3/4" POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value: Web | Connection Value: Outstanding Single Shear: Power Driven Rivets | Connection Value: Outstanding Single Shear: Unfinished Bolts | Framing Distance C | Connection Angles: A.I.S.C. Mark | Connection Angles: Gage g | Connection Angles: Size and Length | Connection Angles: Weight inc. Web Rivets | Connection Details |
|---|---|---|---|---|---|---|---|---|---|---|
| 6" | 11.0 | 10360 | 11930 | 8840 | 3/16 | IC. 6.10 | 2 5/8 | 6" × 4" × 3/8" 0'—2 1/2" Long | 6 lbs. |  |
| 8" | 14.5 | 10800 | 11930 | 8840 | 3/16 | IC. 9.10 | 2 5/8 | 4" × 3 1/2" × 3/8" 0'—5 1/2" Long | 9 lbs. |  |
| | 16.0 | 10800 | 11930 | 8840 | 3/16 | IC. 9.10 | 2 5/8 | | | |
| 10" | 16.5 | 10800 | 11930 | 8840 | 3/16 | IC. 9.10 | 2 5/8 | | | |
| | 19.0 | 11260 | 11930 | 8840 | 3/16 | IC. 9.10 | 2 5/8 | | | |
| 12" | 18.5 | 10800 | 11930 | 8840 | 3/16 | IC. 9.10 | 2 5/8 | | | |
| | 21.0 | 11260 | 11930 | 8840 | 3/16 | IC. 9.10 | 2 5/8 | | | |




*Layer-out starts with this dimension at left end of beam. With beams ordered one half inch short, as recommended for Bethlehem Steel Joists, this leaves sufficient end distance at right end, in case of full allowable 3/8" underrun in beam lengths.

When A = 3" all Bethlehem Steel Joists can be framed opposite with tops flush.

Minimum Web required to develop Single Shearing Value is .33"
Minimum Web required to develop Double Shearing Value is .53"

# ALLOWABLE END REACTIONS FOR BETHLEHEM STEEL JOISTS

DETERMINED BY

# BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 2 1/2" Bearing | Min. Span for 2 1/2" Bearing | Reaction R for 3 1/2" Bearing | Increase in R for 1" Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 6" | 11.0 | .230 | 15000 | 13800 | 2.80 | 17250 | 3450 | 16560 | 3.30 |
| 8" | 14.5 | .240 | 15000 | 16200 | 4.16 | 19800 | 3600 | 23040 | 4.40 |
| | 16.0 | .240 | 15000 | 16300 | 4.75 | 19900 | 3600 | 23390 | 4.47 |
| 10" | 16.5 | .240 | 13960 | 16750 | 5.55 | 20100 | 3350 | 28800 | 6.10 |
| | 19.0 | .250 | 14110 | 17790 | 6.27 | 21320 | 3530 | 30480 | 6.09 |
| 12" | 18.5 | .240 | 12710 | 16770 | 7.25 | 19820 | 3050 | 34560 | 8.33 |
| | 21.0 | .250 | 12910 | 17890 | 8.11 | 21120 | 3230 | 36480 | 8.25 |

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.
When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

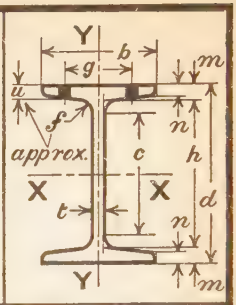
**12″ AND 15″ P**

# SPECIAL PHOENIX I BEAMS

DIMENSIONS—FUNCTIONS—ALLOWABLE TOTAL LOADS

I is Moment of Inertia  S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds.
P is Minimum Span in feet, uniformly loaded to cause V.
R is Allowable End Reaction for 3½″ bearing. For details see page of Allowable End Reactions.
W is Maximum Load on one Standard Connection.
Q is Minimum Span in feet, uniformly loaded to cause W.
w is Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.




## DIMENSIONS AND FUNCTIONS

| Depth = d″ | | | 12″ | 15″ |
|---|---|---|---|---|
| Wt. per foot. | | | 27.5 | 36.0 |
| Area | | | 8.09 | 10.59 |
| b″ | | | 5.00 | 5.50 |
| t | | | .255 | .289 |
| h | | | 10.580 | 13.390 |
| m | | | .710 | .805 |
| n | | | .315 | .371 |
| f | | | .40 | .45 |
| c | | | 9¾ | 12⅝ |
| g | | | 3 | 3½ |
| u | | | ½ | 9/16 |
| AXES | X-X | I | 199.6 | 405.1 |
| | | S | 33.27 | 54.01 |
| | | r | 4.98 | 6.17 |
| | Y-Y | I | 8.70 | 13.50 |
| | | S | 3.48 | 4.91 |
| | | r | 1.04 | 1.13 |
| Coef. Str. | | | 399200 | 648160 |
| Max. Mom. ″# | | | 598800 | 972240 |
| V | | | 36700 | 52000 |
| P. feet | | | 5 44 | 6.23 |
| R | | | 21800 | 26000 |
| W | | | 22950 | 26010 |
| Q. feet | | | 8.70 | 12 46 |
| w lbs. | | | 13 | 19 |
| Rivet dia. | | | ¾ | ¾ |

## ALLOWABLE LOADS AND DEFLECTIONS

Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

| Span feet | 12″ Laterally fixed | 12″ Laterally free | 12″ Total Deflect. | 15″ Laterally fixed | 15″ Laterally free | 15″ Total Deflect. |
|---|---|---|---|---|---|---|
| 4 | 73.4 | 73.4 | .025 | 104 | 104 | .020 |
| 5 | 73.4 | 73.4 | .039 | 104 | 104 | .031 |
| 6 | 66.5 | 66.5 | .056 | 104 | 104 | .045 |
| 7 | 57.0 | 55.5 | .076 | 92.6 | 92.1 | .061 |
| 8 | 49.9 | 46.8 | .099 | 81.0 | 78.1 | .079 |
| 9 | 44.4 | 40.0 | .126 | 72.0 | 67.1 | .101 |
| 10 | 39.9 | 34.4 | .155 | 64.8 | 58.2 | .124 |
| 11 | 36.3 | 29.9 | .188 | 58.9 | 50.8 | .150 |
| 12 | 33.3 | 26.2 | .223 | 54.0 | 44.7 | .179 |
| 13 | 30.7 | 22.9 | .263 | 49.9 | 39.5 | .210 |
| 14 | 28.5 | 20.2 | .304 | 46.3 | 35.1 | .243 |
| 15 | 26.6 | 17.9 | .341 | 43.2 | 31.3 | .279 |
| 16 | 25.0 | 16.0 | .398 | 40.5 | 28.0 | .318 |
| 17 | 23.5 | .... | .449 | 38.1 | 25.1 | .359 |
| 18 | 22.2 | .... | .503 | 36.0 | 22.6 | .402 |
| 19 | 21.0 | .... | .560 | 34.1 | .... | .448 |
| 20 | 20.0 | .... | .621 | 32.4 | .... | .497 |
| 21 | 19.0 | .... | .684 | 30.9 | .... | .547 |
| 22 | 18.1 | .... | .751 | 29.5 | .... | .601 |
| 23 | 17.4 | .... | .822 | 28.2 | .... | .651 |

Deflection: Live Load deflection must not exceed 1-360 of the Span. Live Load Def. = Tot. Def. × Live Load / Tabular Load. Total Deflection in inches for Max. Load; Laterally fixed beam.

# CONNECTION ANGLES FOR SPECIAL PHOENIX I BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS  ¾″ POWER DRIVEN RIVETS

| Beam Depth | Beam Weight per foot | Connection Value Web | Outstanding Single Shear Power Driven Rivets | Outstanding Single Shear Unfinished Bolts | Framing Distance C | Connection Angles A.I.S.C. Mark | Gage g | Size and Length | Weight inc. Web Rivets | Connection Details. |
|---|---|---|---|---|---|---|---|---|---|---|
| 12″ | 27.5 | 22950 | 23860 | 17670 | 3/16 | 1C.13.10 | 2⅝ | | 13 | For complete details see drawing of Connection Angles of same weight as used for American Std. Beams. |
| 15″ | 36.0 | 26010 | 47720 | 35340 | 3/16 | 1C.19.10 | 2⅝ | | 19 | |

# ALLOWABLE END REACTIONS FOR SPECIAL PHOENIX I BEAMS DETERMINED BY BUCKLING OF UNSTIFFENED WEBS OVER VARIOUS LENGTHS OF BEARING

| Depth in Inches | Weight per Foot | Web t | Unit Stress in Buckling | Reaction R for 3½″ Bearing | Min. Span for 3½″ Bearing | Reaction R for 5½″ Bearing | Increase in R for 1″ Additional Bearing | Max. Web Shear V. | Length of Bearing to develop V. |
|---|---|---|---|---|---|---|---|---|---|
| 12 | 27.5 | .255 | 13150 | 21800 | 9.16 | 28500 | 3350 | 36700 | 7.96 |
| 15 | 36.0 | .289 | 12420 | 26000 | 12.46 | 33200 | 3590 | 52000 | 10.74 |

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.
When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

# Part IV
# Section 9

## Beam Summary

giving
Size and Weight
of
Beams
to be used for
Spans
from 4—50 feet
and for
Loads
from 1—650 Kips.

Continuous Load, Uniformly Distributed

# SUMMARY OF BEAMS FOR VARIOUS UNIFORM LOADS AND SPANS

| Size and Kind | Weight per Foot | Section Modulus | SPAN IN FEET—BEAMS LATERALLY FIXED | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 18 | 20 | 22 | 24 |
| 3" I | 5.7 | 1.67 | 5.0 | 4.0 | 3.3 | 2.9 | 2.5 | 2.2 | 2.0 | 1.8 | 1.7 | 1.5 | 1.4 | 1.3 | | | | | |
| 3" I | 6.5 | 1.80 | 5.4 | 4.3 | 3.6 | 3.1 | 2.7 | 2.4 | 2.2 | 2.0 | 1.8 | 1.7 | 1.5 | 1.4 | | | | | |
| 3" I | 7.5 | 1.93 | 5.8 | 4.6 | 3.9 | 3.3 | 2.9 | 2.6 | 2.3 | 2.1 | 1.9 | 1.8 | 1.7 | 1.5 | | | | | |
| 6" J | 4.41 | 2.42 | 7.3 | 5.8 | 4.9 | 4.2 | 3.6 | 3.2 | 2.9 | 2.6 | 2.4 | 2.2 | 2.1 | 1.9 | | | | | |
| 4" I | 7.7 | 3.0 | 9.0 | 7.2 | 6.0 | 5.1 | 4.5 | 4.0 | 3.6 | 3.3 | 3.0 | 2.8 | 2.6 | 2.4 | | | | | |
| 4" I | 8.5 | 3.15 | 10 | 8 | 6 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | | | | | |
| 5" I | 9.5 | 3.35 | 10 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | | | | | |
| 7" J | 5.48 | 3.45 | 10 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | | | | | |
| 4" I | 10.5 | 3.55 | 11 | 9 | 7 | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | | | | | |
| 8" J | 6.54 | 4.65 | 14 | 11 | 9 | 8 | 7 | 6 | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | | |
| 5" I | 10.0 | 4.84 | 15 | 12 | 10 | 8 | 7 | 7 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | | |
| 5" I | 12.25 | 5.40 | 16 | 13 | 11 | 9 | 8 | 7 | 7 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | | |
| 9" J | 7.48 | 5.81 | 17 | 14 | 12 | 10 | 9 | 8 | 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | | |
| 5" I | 14.75 | 6.00 | 18 | 14 | 12 | 10 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | | |
| 6" BJ | 11.0 | 6.43 | 19 | 15 | 13 | 11 | 10 | 9 | 8 | 7 | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 4 | 3 |
| 6" I | 12.5 | 7.27 | 22 | 17 | 15 | 13 | 11 | 10 | 9 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 4 | 4 | 4 |
| 10" J | 8.96 | 7.78 | 23 | 19 | 16 | 13 | 12 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 4 |
| 6" I | 14.75 | 7.93 | 24 | 19 | 16 | 14 | 12 | 11 | 10 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 4 |
| 6" I | 17.25 | 8.67 | 26 | 21 | 17 | 15 | 13 | 12 | 10 | 10 | 9 | 8 | 7 | 7 | 7 | 6 | 5 | 5 | 4 |
| 11" J | 10.23 | 9.63 | 29 | 23 | 19 | 17 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 5 |
| 7" I | 15.3 | 10.34 | 31 | 25 | 21 | 18 | 16 | 14 | 12 | 11 | 10 | 10 | 9 | 8 | 8 | 7 | 6 | 6 | 5 |
| 7" I | 17.5 | 11.11 | 33 | 27 | 22 | 19 | 17 | 15 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 7 | 6 | 6 |
| 8" BJ | 14.5 | 11.23 | 34 | 27 | 22 | 19 | 17 | 15 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 7 | 6 | 6 |
| 7" I | 20.0 | 11.97 | 36 | 29 | 24 | 21 | 18 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 7 | 6 |
| 12" J | 11.74 | 12.01 | 36 | 29 | 24 | 21 | 18 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 7 | 6 |
| 8" BJ | 16.0 | 12.91 | 39 | 31 | 26 | 22 | 19 | 17 | 15 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 6 |
| 8" I | 18.4 | 14.22 | 43 | 34 | 29 | 24 | 21 | 19 | 17 | 16 | 14 | 13 | 12 | 11 | 11 | 9 | 9 | 8 | 7 |
| 8" Cm | 17.5 | 14.35 | 43 | 34 | 29 | 25 | 22 | 19 | 17 | 16 | 14 | 13 | 12 | 11 | 11 | | | | |
| 8" B | 17.5 | 14.43 | 43 | 35 | 29 | 25 | 22 | 19 | 17 | 16 | 14 | 13 | 12 | 12 | 11 | 10 | 9 | | |
| 8" I | 20.5 | 15.05 | 45 | 36 | 30 | 26 | 23 | 20 | 18 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 8 |
| 10" BJ | 16.5 | 15.48 | 46 | 37 | 31 | 27 | 23 | 21 | 19 | 17 | 15 | 14 | 13 | 12 | 12 | 10 | 9 | 8 | 8 |
| 8" B | 19.0 | 15.81 | 47 | 38 | 32 | 27 | 24 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 9 | | |
| 8" Cm | 21.0 | 15.85 | 48 | 38 | 32 | 27 | 24 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | | |
| 8" I | 23.0 | 16.05 | 48 | 39 | 32 | 28 | 24 | 21 | 19 | 18 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 8" I | 25.5 | 17.02 | 51 | 41 | 34 | 29 | 26 | 23 | 20 | 19 | 17 | 16 | 15 | 14 | 13 | 11 | 10 | 9 | 9 |
| 10" BJ | 19.0 | 18.60 | 56 | 45 | 37 | 32 | 28 | 25 | 22 | 20 | 19 | 17 | 16 | 15 | 14 | 12 | 11 | 10 | 9 |
| 9" I | 21.8 | 18.87 | 57 | 45 | 38 | 32 | 28 | 25 | 23 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 11 | 10 | 9 |
| 9" B | 20.5 | 19.22 | 54 | 46 | 39 | 33 | 29 | 26 | 23 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 11 | | |
| 9" Cm | 20.5 | 19.24 | 51 | 46 | 39 | 33 | 29 | 26 | 23 | 21 | 19 | 18 | 17 | 15 | 14 | 13 | 12 | | |
| 12" BJ | 18.5 | 20.25 | 61 | 49 | 41 | 35 | 30 | 27 | 24 | 22 | 20 | 19 | 17 | 16 | 15 | 14 | 12 | 11 | 10 |
| 9" I | 25.0 | 20.31 | 61 | 49 | 41 | 35 | 31 | 27 | 24 | 22 | 20 | 19 | 17 | 16 | 15 | 14 | 12 | 11 | 10 |
| 9" B | 22.0 | 20.73 | 57 | 50 | 42 | 36 | 31 | 28 | 25 | 23 | 21 | 19 | 18 | 17 | 16 | 14 | 12 | | |
| 8" C | 24.0 | 21.08 | 46 | 46 | 42 | 36 | 32 | 28 | 25 | 23 | 21 | 19 | 18 | 17 | 16 | 14 | 13 | 12 | 11 |
| 9" Cm | 25.0 | 21.22 | 64 | 51 | 42 | 36 | 32 | 28 | 26 | 23 | 21 | 20 | 18 | 17 | 16 | 14 | 13 | | |
| 10" C | 21.0 | 21.73 | 55 | 52 | 44 | 37 | 33 | 29 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 15 | 13 | 12 | 11 |
| 10" B | 21.0 | 21.84 | 57 | 52 | 44 | 38 | 33 | 29 | 26 | 24 | 22 | 20 | 19 | 18 | 16 | 15 | 13 | 12 | 11 |
| 9" I | 30.0 | 22.53 | 68 | 54 | 45 | 39 | 34 | 30 | 27 | 25 | 23 | 21 | 19 | 18 | 17 | 15 | 14 | 12 | 11 |
| 8" C | 27.0 | 23.68 | 52 | 52 | 47 | 41 | 36 | 32 | 28 | 26 | 24 | 22 | 20 | 19 | 18 | 16 | 14 | 13 | 12 |
| 12" BJ | 21.0 | 24.18 | 73 | 58 | 48 | 41 | 36 | 32 | 29 | 26 | 24 | 22 | 21 | 19 | 18 | 16 | 15 | 13 | 12 |
| 10" I | 25.4 | 24.42 | 73 | 59 | 49 | 42 | 37 | 33 | 29 | 26 | 24 | 23 | 21 | 20 | 18 | 16 | 15 | 13 | 12 |
| 10" C | 23.0 | 24.44 | 55 | 55 | 49 | 42 | 37 | 33 | 29 | 27 | 24 | 23 | 21 | 20 | 18 | 16 | 15 | 13 | 12 |
| 10" B | 23.5 | 24.64 | 60 | 59 | 49 | 42 | 37 | 33 | 30 | 27 | 25 | 23 | 21 | 20 | 19 | 16 | 15 | 13 | 12 |
| 9" I | 35.0 | 24.73 | 74 | 59 | 50 | 42 | 37 | 33 | 30 | 27 | 25 | 23 | 21 | 20 | 19 | 17 | 15 | 13 | 12 |
| 8" G | 29.5 | 25.56 | 54 | 54 | 51 | 44 | 38 | 34 | 31 | 28 | 26 | 24 | 22 | 20 | 19 | 17 | 15 | 14 | 12 |
| 8" C | 30.0 | 26.31 | 59 | 59 | 53 | 45 | 40 | 35 | 32 | 29 | 26 | 24 | 23 | 21 | 20 | 18 | 16 | 14 | 13 |
| 10" I | 30.0 | 26.70 | 80 | 64 | 53 | 46 | 40 | 36 | 32 | 29 | 27 | 25 | 23 | 21 | 20 | 18 | 16 | 15 | 13 |
| 10" B | 26.0 | 27.33 | 65 | 65 | 55 | 47 | 41 | 36 | 33 | 30 | 27 | 25 | 23 | 22 | 21 | 18 | 16 | 15 | 14 |
| 8" C | 31.0 | 27.52 | 56 | 56 | 55 | 47 | 41 | 37 | 33 | 30 | 28 | 25 | 24 | 22 | 21 | 18 | 17 | 15 | 14 |
| 10" C | 26.0 | 27.63 | 63 | 63 | 55 | 47 | 41 | 37 | 33 | 30 | 28 | 26 | 24 | 22 | 21 | 18 | 17 | 15 | 14 |
| 9" C | 29.0 | 28.00 | 60 | 60 | 56 | 48 | 42 | 37 | 34 | 31 | 28 | 26 | 24 | 22 | 21 | 19 | 17 | 15 | 14 |
| 8" G | 33.0 | 29.03 | 56 | 56 | 56 | 50 | 44 | 39 | 35 | 32 | 29 | 27 | 25 | 23 | 22 | 19 | 17 | 16 | 15 |
| 10" I | 35.0 | 29.16 | 88 | 70 | 58 | 50 | 44 | 39 | 35 | 32 | 29 | 27 | 25 | 23 | 22 | 19 | 18 | 16 | 15 |
| 10" B | 28.5 | 30.25 | 70 | 70 | 61 | 52 | 45 | 40 | 36 | 33 | 30 | 28 | 26 | 24 | 23 | 20 | 18 | 16 | 15 |
| 12" C | 25.0 | 30.69 | 69 | 69 | 61 | 53 | 46 | 41 | 37 | 34 | 31 | 28 | 26 | 25 | 23 | 21 | 18 | 17 | 15 |
| 9" C | 32.0 | 30.89 | 67 | 67 | 62 | 53 | 46 | 41 | 37 | 34 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 17 | 15 |
| 12" B | 25.0 | 31.16 | 68 | 68 | 62 | 53 | 47 | 42 | 37 | 34 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 17 | 16 |
| 10" I | 40.0 | 31.60 | 95 | 76 | 63 | 54 | 47 | 42 | 38 | 35 | 32 | 29 | 27 | 25 | 24 | 21 | 19 | 17 | 16 |
| 10" C | 30.0 | 31.91 | 73 | 73 | 64 | 55 | 48 | 43 | 38 | 35 | 32 | 30 | 27 | 26 | 24 | 21 | 19 | 17 | 16 |

LOADS BY A. I. S. C. SPECIFICATION

# SUMMARY OF BEAMS FOR VARIOUS UNIFORM LOADS AND SPANS

| Size and Kind | Weight per Foot | Section Modulus | SPAN IN FEET — BEAMS LATERALLY FIXED | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 6 | 8 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| 8″ C | 36.0 | 32.03 | 66 | 64 | 48 | 38 | 35 | 32 | 30 | 28 | 26 | 24 | 21 | 19 | 18 | 16 | | | |
| 8″ G | 36.5 | 32.66 | 60 | 60 | 49 | 39 | 36 | 33 | 30 | 28 | 26 | 24 | 22 | 20 | 18 | 16 | | | |
| 10″ C | 31.0 | 32.68 | 77 | 65 | 49 | 39 | 36 | 33 | 30 | 28 | 26 | 25 | 22 | 20 | 18 | 16 | | | |
| 12″ P | 27.5 | 33.27 | 73 | 67 | 50 | 40 | 36 | 33 | 31 | 29 | 27 | 25 | 22 | 20 | 18 | | | | |
| 9″ C | 35.0 | 33.81 | 74 | 68 | 51 | 41 | 37 | 34 | 31 | 29 | 27 | 25 | 23 | 20 | 18 | 17 | | | |
| 10″ C | 36.0 | 35.12 | 105 | 70 | 53 | 42 | 38 | 35 | 32 | 30 | 28 | 26 | 23 | 21 | 19 | 18 | | | |
| 12″ C | 28.0 | 35.57 | 69 | 69 | 53 | 43 | 39 | 36 | 33 | 31 | 28 | 27 | 24 | 21 | 19 | 18 | | | |
| 12″ B | 28.0 | 35.60 | 71 | 71 | 53 | 43 | 39 | 36 | 33 | 31 | 28 | 27 | 24 | 21 | 19 | 18 | | | |
| 9″ G | 36.0 | 35.91 | 62 | 62 | 54 | 43 | 39 | 36 | 33 | 31 | 29 | 27 | 24 | 22 | 20 | 18 | | | |
| 12″ I | 31.8 | 35.97 | 101 | 72 | 54 | 43 | 39 | 36 | 33 | 31 | 29 | 27 | 24 | 22 | 20 | 18 | | | |
| 8″ C | 42.0 | 37 37 | 78 | 75 | 56 | 45 | 41 | 37 | 35 | 32 | 30 | 28 | 25 | 22 | 20 | 19 | | | |
| 12″ I | 35.0 | 37.83 | 114 | 76 | 57 | 45 | 41 | 38 | 35 | 32 | 30 | 28 | 25 | 23 | 21 | 19 | | | |
| 9″ C | 38.0 | 37 87 | 68 | 68 | 57 | 45 | 41 | 38 | 35 | 33 | 30 | 28 | 25 | 23 | 21 | 19 | | | |
| 10″ C | 42.0 | 38 08 | 114 | 76 | 57 | 46 | 42 | 38 | 35 | 33 | 31 | 29 | 25 | 23 | 21 | 19 | | | |
| 9″ G | 38.5 | 38.20 | 67 | 67 | 57 | 46 | 42 | 38 | 35 | 33 | 31 | 29 | 25 | 23 | 21 | 19 | | | |
| 12″ C | 34.0 | 39.61 | 108 | 79 | 59 | 48 | 43 | 40 | 37 | 34 | 32 | 30 | 26 | 24 | 22 | 20 | | | |
| 12″ B | 31.5 | 40.54 | 79 | 79 | 61 | 49 | 44 | 41 | 37 | 35 | 32 | 30 | 27 | 24 | 22 | 20 | | | |
| 12″ C | 32.0 | 40.65 | 80 | 80 | 61 | 49 | 44 | 41 | 38 | 35 | 33 | 31 | 27 | 24 | 22 | 20 | | | |
| 14″ C | 30.0 | 41.82 | 91 | 84 | 63 | 50 | 46 | 42 | 39 | 36 | 34 | 31 | 28 | 25 | 23 | 21 | 19 | 18 | 17 |
| 14″ B | 30.0 | 42.49 | 88 | 85 | 64 | 51 | 46 | 43 | 39 | 36 | 34 | 32 | 28 | 26 | 23 | 21 | 20 | 18 | 17 |
| 9″ G | 43.5 | 42.85 | 77 | 77 | 64 | 51 | 47 | 43 | 40 | 37 | 34 | 32 | 29 | 26 | 23 | 21 | | | |
| 9″ C | 43.0 | 42 86 | 78 | 78 | 64 | 51 | 47 | 43 | 40 | 37 | 34 | 32 | 29 | 26 | 23 | 21 | | | |
| 12″ I | 40.8 | 44.82 | 132 | 90 | 67 | 54 | 49 | 45 | 41 | 38 | 36 | 34 | 30 | 27 | 24 | 22 | | | |
| 10″ G | 41.5 | 45.57 | 74 | 74 | 68 | 55 | 50 | 46 | 42 | 39 | 36 | 34 | 30 | 27 | 25 | 23 | | | |
| 12″ C | 36.0 | 45.78 | 90 | 90 | 69 | 55 | 50 | 46 | 42 | 39 | 37 | 34 | 31 | 28 | 25 | 23 | | | |
| 12″ B | 36.0 | 46.01 | 88 | 88 | 69 | 55 | 50 | 46 | 42 | 39 | 37 | 35 | 31 | 28 | 25 | 23 | | | |
| 12″ I | 45.0 | 47.35 | 142 | 95 | 71 | 57 | 52 | 47 | 44 | 41 | 38 | 36 | 32 | 28 | 26 | 24 | | | |
| 14″ C | 33.0 | 47.63 | 91 | 91 | 72 | 57 | 52 | 48 | 44 | 41 | 38 | 36 | 32 | 29 | 26 | 24 | 22 | 20 | 19 |
| 14″ B | 33.0 | 47.76 | 89 | 89 | 72 | 57 | 52 | 48 | 44 | 41 | 38 | 36 | 32 | 29 | 26 | 24 | 22 | 21 | 19 |
| 9″ C | 48.0 | 47.85 | 88 | 88 | 72 | 57 | 52 | 48 | 44 | 41 | 38 | 36 | 32 | 29 | 26 | 24 | | | |
| 10″ G | 44.5 | 49.34 | 77 | 77 | 74 | 59 | 54 | 49 | 46 | 42 | 39 | 37 | 33 | 30 | 27 | 25 | | | |
| 12″ B | 40.0 | 50.20 | 95 | 95 | 75 | 60 | 55 | 50 | 46 | 43 | 40 | 38 | 33 | 30 | 27 | 25 | | | |
| 12″ I | 50.0 | 50.27 | 151 | 101 | 75 | 60 | 55 | 50 | 46 | 43 | 40 | 38 | 34 | 30 | 27 | 25 | | | |
| 14″ C | 38.0 | 51.07 | 126 | 102 | 77 | 61 | 56 | 51 | 47 | 44 | 41 | 38 | 34 | 31 | 28 | 26 | 24 | 22 | 20 |
| 14″ C | 36.0 | 51.93 | 99 | 99 | 78 | 62 | 57 | 52 | 48 | 45 | 42 | 39 | 35 | 31 | 28 | 26 | 24 | 22 | 21 |
| 12″ C | 40.0 | 52.28 | 84 | 84 | 78 | 63 | 57 | 52 | 48 | 45 | 42 | 39 | 35 | 31 | 29 | 26 | | | |
| 12″ I | 55.0 | 53.22 | 160 | 106 | 80 | 64 | 58 | 53 | 49 | 46 | 43 | 40 | 36 | 32 | 29 | 27 | | | |
| 15″ P | 36.0 | 54.01 | 104 | 104 | 81 | 65 | 59 | 54 | 50 | 46 | 43 | 41 | 36 | 32 | 30 | 27 | | | |
| 14″ B | 37.5 | 54.35 | 103 | 103 | 82 | 65 | 59 | 54 | 50 | 47 | 44 | 41 | 36 | 33 | 30 | 27 | 25 | 23 | 22 |
| 10″ C | 49.0 | 54.40 | 84 | 84 | 82 | 65 | 59 | 54 | 50 | 47 | 44 | 41 | 36 | 33 | 30 | 27 | | | |
| 16″ C | 35.0 | 54.68 | 111 | 109 | 82 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | 37 | 33 | 30 | 27 | 25 | 24 | 22 |
| 10″ G | 50.0 | 54.84 | 87 | 87 | 82 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | 37 | 33 | 30 | 27 | | | |
| 15″ B | 36.0 | 55.12 | 100 | 100 | 83 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | 37 | 33 | 30 | 28 | 25 | 24 | 22 |
| 16″ B | 35.0 | 55.13 | 108 | 108 | 83 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | 37 | 33 | 30 | 28 | 25 | 24 | 22 |
| 12″ B | 44.0 | 55.30 | 105 | 105 | 83 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | 37 | 33 | 30 | 28 | | | |
| 14″ C | 39.0 | 56.26 | 108 | 108 | 84 | 68 | 61 | 56 | 52 | 48 | 45 | 42 | 38 | 34 | 31 | 28 | 26 | 24 | 23 |
| 10″ C | 54.0 | 56.86 | 119 | 114 | 85 | 68 | 62 | 57 | 52 | 49 | 45 | 43 | 38 | 34 | 31 | 28 | | | |
| 12″ C | 45.0 | 58.85 | 95 | 95 | 88 | 71 | 64 | 59 | 54 | 50 | 47 | 44 | 39 | 35 | 32 | 29 | | | |
| 15″ I | 42.9 | 58.91 | 148 | 118 | 88 | 71 | 64 | 59 | 54 | 50 | 47 | 44 | 39 | 35 | 32 | 29 | 27 | 25 | 24 |
| 10″ C | 59.0 | 59.30 | 155 | 119 | 89 | 71 | 65 | 59 | 55 | 51 | 47 | 44 | 40 | 36 | 32 | 30 | | | |
| 16″ C | 38.0 | 59.34 | 121 | 118 | 89 | 71 | 65 | 59 | 55 | 51 | 47 | 44 | 40 | 36 | 32 | 30 | 27 | 25 | 24 |
| 15″ B | 38.5 | 59 68 | 104 | 104 | 90 | 72 | 65 | 60 | 55 | 51 | 48 | 45 | 40 | 36 | 33 | 30 | 28 | 26 | 24 |
| 15″ I | 45.0 | 60.48 | 163 | 121 | 91 | 73 | 66 | 60 | 56 | 52 | 48 | 45 | 40 | 36 | 33 | 30 | 28 | 26 | 24 |
| 14″ C | 42.0 | 60 60 | 117 | 117 | 91 | 73 | 66 | 61 | 56 | 52 | 49 | 46 | 40 | 36 | 33 | 30 | 28 | 26 | 24 |
| 12″ B | 48.5 | 60 93 | 116 | 116 | 91 | 73 | 66 | 61 | 56 | 52 | 49 | 46 | 41 | 37 | 33 | 30 | | | |
| 14″ B | 42 0 | 61.26 | 116 | 116 | 92 | 74 | 67 | 61 | 57 | 53 | 49 | 46 | 41 | 37 | 33 | 31 | 28 | 26 | 25 |
| 15″ B | 40 0 | 61.65 | 110 | 110 | 92 | 74 | 67 | 62 | 57 | 53 | 49 | 46 | 41 | 37 | 34 | 31 | 28 | 26 | 25 |
| 10″ C | 64.0 | 61.76 | 185 | 124 | 93 | 74 | 67 | 62 | 57 | 53 | 49 | 46 | 41 | 37 | 34 | 31 | | | |
| 15″ I | 50.0 | 64.15 | 192 | 128 | 96 | 77 | 70 | 64 | 59 | 55 | 51 | 48 | 43 | 38 | 35 | 32 | 30 | 27 | 26 |
| 15″ B | 42.5 | 65.21 | 118 | 118 | 98 | 78 | 71 | 65 | 60 | 56 | 52 | 49 | 43 | 39 | 36 | 33 | 30 | 28 | 26 |
| 12″ C | 50 0 | 65 35 | 106 | 106 | 98 | 78 | 71 | 65 | 60 | 56 | 52 | 49 | 44 | 39 | 36 | 33 | | | |
| 16″ C | 40.0 | 65.58 | 111 | 111 | 98 | 79 | 72 | 66 | 61 | 56 | 52 | 49 | 44 | 39 | 36 | 33 | 30 | 28 | 26 |
| 16″ C | 43.0 | 65.75 | 143 | 132 | 99 | 79 | 72 | 66 | 61 | 56 | 53 | 49 | 44 | 40 | 36 | 33 | 30 | 28 | 26 |
| 16″ B | 40 0 | 65.78 | 113 | 113 | 99 | 79 | 72 | 66 | 61 | 56 | 53 | 49 | 44 | 40 | 36 | 33 | 30 | 28 | 26 |
| 12″ G | 51.5 | 67.27 | 103 | 103 | 101 | 81 | 73 | 67 | 62 | 58 | 54 | 50 | 45 | 40 | 37 | 34 | | | |

# SUMMARY OF BEAMS FOR VARIOUS UNIFORM LOADS AND SPANS

| Size and Kind | Weight per Foot | Section Modulus | SPAN IN FEET—BEAMS LATERALLY FIXED | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 |
| 15″ I | 55.0 | 67.83 | 136 | 102 | 81 | 68 | 58 | 51 | 45 | 41 | 37 | 34 | 31 | 29 | 27 | | | | |
| 15″ B | 46.0 | 68.91 | 129 | 103 | 83 | 69 | 59 | 52 | 46 | 41 | 38 | 35 | 32 | 30 | 28 | | | | |
| 14″ C | 48.0 | 70.86 | 115 | 106 | 85 | 71 | 61 | 53 | 47 | 43 | 39 | 35 | 33 | 30 | 28 | | | | |
| 12″ C | 55.0 | 71.40 | 108 | 107 | 86 | 71 | 61 | 54 | 48 | 43 | 39 | 36 | 33 | | | | | | |
| 12″ G | 55.5 | 72.60 | 109 | 109 | 87 | 73 | 62 | 54 | 48 | 44 | 40 | 36 | 33 | | | | | | |
| 16″ B | 45.0 | 73 76 | 128 | 111 | 89 | 74 | 63 | 55 | 49 | 44 | 40 | 37 | 34 | 32 | 30 | | | | |
| 16″ C | 45.0 | 73.78 | 126 | 111 | 89 | 74 | 63 | 55 | 49 | 44 | 40 | 37 | 34 | 32 | 30 | | | | |
| 15″ B | 50.5 | 75.71 | 137 | 114 | 91 | 76 | . | 57 | 50 | 45 | 41 | 38 | 35 | 32 | 30 | | | | |
| 12″ C | 60.0 | 77.90 | 119 | 117 | 93 | 78 | 67 | 58 | 52 | 47 | 43 | 39 | 36 | | | | | | |
| 14″ C | 53.0 | 78.25 | 128 | 117 | 94 | 78 | 67 | 59 | 52 | 47 | 43 | 39 | 36 | 34 | 31 | | | | |
| 12″ G | 61.0 | 79.80 | 119 | 119 | 96 | 80 | 68 | 60 | 53 | 48 | 44 | 40 | 37 | | | | | | |
| 15″ I | 60.8 | 81.20 | 162 | 122 | 97 | 81 | 70 | 61 | 54 | 49 | 44 | 41 | 37 | 35 | 32 | | | | |
| 16″ C | 50.0 | 81.95 | 141 | 123 | 98 | 82 | 70 | 61 | 55 | 49 | 45 | 41 | 38 | 35 | 33 | | | | |
| 15″ B | 54.5 | 82.27 | 148 | 123 | 99 | 82 | 71 | 62 | 55 | 49 | 45 | 41 | 38 | 35 | 33 | | | | |
| 16″ B | 50.0 | 82.34 | 142 | 124 | 99 | 82 | 71 | 62 | 55 | 49 | 45 | 41 | 38 | 35 | 33 | 31 | | | |
| 12″ G | 66.0 | 83.65 | 128 | 126 | 100 | 84 | 72 | 63 | 56 | 50 | 46 | 42 | 39 | | | | | | |
| 15″ I | 65.0 | 84.28 | 169 | 126 | 101 | 84 | 72 | 63 | 56 | 51 | 46 | 42 | 39 | 36 | 34 | | | | |
| 18″ B | 47.0 | 85.18 | 140 | 128 | 102 | 85 | 73 | 64 | 57 | 51 | 47 | 43 | 39 | 37 | 34 | 32 | 30 | 28 | |
| 18″ C | 47.0 | 85.40 | 138 | 128 | 102 | 85 | 73 | 64 | 57 | 51 | 47 | 43 | 39 | 37 | 34 | 32 | 30 | 28 | |
| 14″ C | 58.0 | 85.58 | 141 | 128 | 103 | 86 | 73 | 64 | 57 | 51 | 47 | 43 | 40 | 37 | 34 | | | | |
| 12″ C | 66.0 | 85 76 | 132 | 129 | 103 | 86 | 74 | 64 | 57 | 51 | 47 | 43 | 40 | | | | | | |
| 12″ C | 65.0 | 86 88 | 115 | 115 | 104 | 87 | 75 | 65 | 58 | 52 | 47 | 43 | 40 | | | | | | |
| 15″ I | 70.0 | 87.95 | 176 | 132 | 106 | 88 | 75 | 66 | 59 | 53 | 48 | 44 | 41 | 38 | 35 | | | | |
| 18″ I | 54.7 | 88.39 | 177 | 133 | 106 | 88 | 76 | 66 | 59 | 53 | 48 | 44 | 41 | 38 | 35 | 33 | 31 | 29 | |
| 18″ B | 49.0 | 89.20 | 143 | 134 | 107 | 89 | 76 | 67 | 59 | 54 | 49 | 45 | 41 | 38 | 36 | 33 | 31 | 30 | |
| 15″ B | 59.5 | 89.44 | 163 | 134 | 107 | 89 | 77 | 67 | 60 | 54 | 49 | 45 | 41 | 38 | 36 | | | | |
| 12″ C | 70.0 | 89.83 | 151 | 135 | 108 | 90 | 77 | 67 | 60 | 54 | 49 | 45 | 41 | | | | | | |
| 18″ C | 51.0 | 89.88 | 162 | 135 | 108 | 90 | 77 | 67 | 60 | 54 | 49 | 45 | 41 | 39 | 36 | 34 | 32 | 30 | |
| 12″ G | 70.5 | 90.60 | 135 | 135 | 109 | 91 | 78 | 68 | 60 | 54 | 49 | 45 | 42 | | | | | | |
| 15″ I | 75.0 | 91.63 | 183 | 137 | 110 | 92 | 79 | 69 | 61 | 55 | 50 | 46 | 42 | 39 | 37 | | | | |
| 18″ I | 60 0 | 93.09 | 186 | 140 | 112 | 93 | 80 | 70 | 62 | 56 | 51 | 47 | 43 | 40 | 37 | 35 | 33 | 31 | |
| 14″ C | 61 0 | 93.12 | 129 | 129 | 112 | 93 | 80 | 70 | 62 | 56 | 51 | 47 | 43 | 40 | 37 | | | | |
| 12″ C | 76.0 | 93.36 | 187 | 140 | 112 | 93 | 80 | 70 | 62 | 56 | 51 | 47 | 43 | | | | | | |
| 16″ B | 56.5 | 93.49 | 143 | 140 | 112 | 94 | 80 | 70 | 62 | 56 | 51 | 47 | 43 | 40 | 37 | 35 | | | |
| 18″ B | 52.0 | 94.32 | 154 | 141 | 113 | 94 | 81 | 71 | 63 | 57 | 51 | 47 | 44 | 40 | 38 | 35 | 33 | 31 | |
| 18″ C | 52 0 | 94.41 | 154 | 142 | 113 | 94 | 81 | 71 | 63 | 57 | 52 | 47 | 44 | 40 | 38 | 35 | 33 | 31 | |
| 16″ C | 58.0 | 97.08 | 144 | 144 | 117 | 97 | 83 | 73 | 65 | 58 | 53 | 49 | 45 | 42 | 39 | 36 | 34 | | |
| 18″ I | 65.0 | 97.53 | 195 | 146 | 117 | 98 | 84 | 73 | 65 | 59 | 53 | 49 | 45 | 42 | 39 | 37 | 34 | 32 | |
| 12″ G | 76.5 | 98.05 | 148 | 147 | 118 | 98 | 84 | 74 | 65 | 59 | 54 | 49 | 45 | | | | | | |
| 18″ B | 54.5 | 98.91 | 161 | 148 | 119 | 99 | 85 | 74 | 66 | 59 | 54 | 49 | 46 | 42 | 40 | 37 | 35 | 33 | |
| 16″ B | 60.5 | 101.51 | 150 | 150 | 122 | 102 | 87 | 76 | 68 | 61 | 55 | 51 | 47 | 44 | 41 | 38 | | | |
| 18″ I | 70.0 | 101.94 | 204 | 153 | 122 | 102 | 87 | 76 | 68 | 61 | 56 | 51 | 47 | 44 | 41 | 38 | 36 | 34 | |
| 14″ C | 68.0 | 103.78 | 145 | 145 | 125 | 104 | 89 | 78 | 69 | 62 | 57 | 52 | 48 | 45 | 42 | | | | |
| 15″ G | 64 5 | 104.13 | 139 | 139 | 125 | 104 | 89 | 78 | 69 | 63 | 57 | 52 | 48 | 45 | 42 | 39 | 37 | | |
| 18″ C | 58.0 | 105.28 | 172 | 158 | 126 | 105 | 90 | 79 | 70 | 63 | 57 | 53 | 49 | 45 | 42 | 39 | 37 | 35 | |
| 16″ C | 63.0 | 105.49 | 157 | 157 | 127 | 106 | 90 | 79 | 70 | 63 | 58 | 53 | 49 | 45 | 42 | 40 | 37 | | |
| 15″ B | 71.5 | 106.60 | 187 | 160 | 128 | 107 | 91 | 80 | 71 | 64 | 58 | 53 | 49 | 46 | 43 | | | | |
| 18″ B | 59.0 | 108.20 | 162 | 162 | 130 | 108 | 93 | 81 | 72 | 65 | 59 | 54 | 50 | 46 | 43 | 41 | 38 | 36 | |
| 20″ B | 56 0 | 109 27 | 179 | 164 | 131 | 109 | 94 | 82 | 73 | 66 | 60 | 55 | 50 | 47 | 44 | 41 | 39 | 36 | 35 |
| 15″ G | 69.0 | 109.58 | 150 | 150 | 132 | 110 | 94 | 82 | 73 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | 39 | 37 | |
| 16″ B | 66 0 | 110.22 | 162 | 162 | 132 | 110 | 95 | 83 | 74 | 66 | 60 | 55 | 51 | 47 | 44 | 41 | | | |
| 21″ C | 55 0 | 111.70 | 180 | 168 | 134 | 112 | 96 | 84 | 74 | 67 | 61 | 56 | 52 | 48 | 45 | 42 | 39 | 37 | 35 |
| 22″ B | 54.5 | 113.34 | 188 | 170 | 136 | 113 | 97 | 85 | 76 | 68 | 62 | 57 | 52 | 49 | 45 | 43 | 40 | 38 | 36 |
| 16″ C | 68 0 | 113 85 | 171 | 171 | 137 | 114 | 98 | 85 | 76 | 68 | 62 | 57 | 53 | 49 | 46 | 43 | 40 | | |
| 14″ C | 75.0 | 114.52 | 162 | 162 | 137 | 115 | 98 | 86 | 76 | 69 | 63 | 57 | 53 | 49 | 46 | | | | |
| 20″ I | 65.4 | 116.95 | 234 | 175 | 140 | 117 | 100 | 88 | 78 | 70 | 64 | 58 | 54 | 50 | 47 | 44 | 41 | 39 | 37 |
| 20″ B | 59.5 | 118.15 | 180 | 177 | 142 | 118 | 101 | 89 | 79 | 71 | 64 | 59 | 55 | 51 | 47 | 44 | 42 | 39 | 37 |
| 18″ B | 64.5 | 118.53 | 172 | 172 | 142 | 119 | 102 | 89 | 79 | 71 | 65 | 59 | 55 | 51 | 47 | 44 | 42 | 40 | |
| 15″ G | 74.0 | 119.03 | 158 | 158 | 143 | 119 | 102 | 89 | 79 | 71 | 65 | 60 | 55 | 51 | 48 | 45 | 42 | 40 | |
| 16″ B | 71.5 | 119.82 | 177 | 177 | 144 | 120 | 103 | 90 | 80 | 72 | 65 | 60 | 55 | 51 | 48 | 45 | | | |
| 21″ C | 58 0 | 120.30 | 181 | 180 | 144 | 120 | 103 | 90 | 80 | 72 | 66 | 60 | 56 | 52 | 48 | 45 | 42 | 40 | 38 |
| 20″ I | 70 0 | 121.42 | 243 | 182 | 146 | 121 | 104 | 91 | 81 | 73 | 66 | 61 | 56 | 52 | 49 | 46 | 43 | 40 | 38 |
| 20″ B | 62.0 | 123.61 | 188 | 185 | 148 | 124 | 106 | 93 | 82 | 74 | 67 | 62 | 57 | 53 | 49 | 46 | 44 | 41 | 39 |
| 18″ C | 67.0 | 124 12 | 175 | 175 | 149 | 124 | 106 | 93 | 83 | 74 | 68 | 62 | 57 | 53 | 50 | 47 | 44 | 41 | |
| 22″ B | 58.0 | 124 67 | 189 | 187 | 150 | 125 | 107 | 94 | 83 | 75 | 68 | 62 | 58 | 53 | 50 | 47 | 44 | 42 | 39 |
| 20″ I | 75.0 | 126.35 | 253 | 190 | 152 | 126 | 108 | 95 | 84 | 76 | 69 | 63 | 58 | 54 | 51 | 47 | 45 | 42 | 40 |
| 18″ I | 75.6 | 126.87 | 242 | 190 | 152 | 127 | 109 | 95 | 85 | 76 | 69 | 63 | 59 | 54 | 51 | 48 | 45 | 42 | |

# SUMMARY OF BEAMS FOR VARIOUS UNIFORM LOADS AND SPANS

| Size and Kind | Weight per Foot | Section Modulus | SPAN IN FEET—BEAMS LATERALLY FIXED | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| 18″ B | 69.0 | 128.19 | 181 | 154 | 128 | 110 | 96 | 85 | 77 | 70 | 64 | 59 | 55 | 51 | 48 | 45 | 43 | | |
| 20″ B | 64.5 | 128.74 | 193 | 154 | 129 | 110 | 97 | 86 | 77 | 70 | 64 | 59 | 55 | 51 | 48 | 45 | 43 | 41 | |
| 15″ G | 80.5 | 129.29 | 174 | 155 | 129 | 111 | 97 | 86 | 78 | 71 | 65 | 60 | 55 | 52 | 48 | 46 | 43 | | |
| 16″ G | 74.5 | 130.18 | 149 | 149 | 130 | 112 | 98 | 87 | 78 | 71 | 65 | 60 | 56 | 52 | 49 | 46 | 43 | | |
| 18″ I | 80.0 | 130.76 | 196 | 157 | 131 | 112 | 98 | 87 | 78 | 71 | 65 | 60 | 56 | 52 | 49 | 46 | 44 | | |
| 14″ C | 85.0 | 131.61 | 146 | 146 | 132 | 113 | 99 | 88 | 79 | 72 | 66 | 61 | 56 | 53 | | | | | |
| 16″ C | 76.0 | 132.66 | 161 | 159 | 133 | 114 | 100 | 88 | 80 | 72 | 66 | 61 | 57 | 53 | 50 | 47 | | | |
| 21″ C | 64.0 | 132.85 | 199 | 159 | 133 | 114 | 100 | 89 | 80 | 72 | 66 | 61 | 57 | 53 | 50 | 47 | 44 | 42 | |
| 18″ C | 72.0 | 133.42 | 190 | 160 | 133 | 114 | 100 | 89 | 80 | 73 | 67 | 62 | 57 | 53 | 50 | 47 | 44 | | |
| 18″ I | 85.0 | 135.18 | 203 | 162 | 135 | 116 | 101 | 90 | 81 | 74 | 68 | 62 | 58 | 54 | 51 | 48 | 45 | | |
| 22″ B | 62.5 | 135.95 | 195 | 163 | 136 | 117 | 102 | 91 | 82 | 74 | 68 | 63 | 58 | 54 | 51 | 48 | 45 | 43 | |
| 20″ B | 68.5 | 137.42 | 196 | 165 | 137 | 118 | 103 | 92 | 83 | 75 | 69 | 63 | 59 | 55 | 52 | 49 | 46 | 43 | |
| 18″ B | 74.0 | 137.88 | 191 | 165 | 138 | 118 | 103 | 92 | 83 | 75 | 69 | 64 | 59 | 55 | 52 | 49 | 46 | | |
| 18″ I | 90.0 | 139.61 | 209 | 168 | 140 | 120 | 105 | 93 | 84 | 76 | 70 | 64 | 60 | 56 | 52 | 49 | 47 | | |
| 16″ G | 81.0 | 141.41 | 161 | 171 | 141 | 121 | 106 | 94 | 85 | 77 | 71 | 65 | 61 | 57 | 53 | 50 | 47 | | |
| 18″ C | 78.0 | 144.59 | 206 | 174 | 145 | 124 | 108 | 96 | 87 | 79 | 72 | 67 | 62 | 58 | 54 | 51 | 48 | | |
| 16″ C | 83.0 | 144.88 | 177 | 174 | 145 | 124 | 109 | 97 | 87 | 79 | 72 | 67 | 62 | 58 | 54 | 51 | | | |
| 21″ C | 70.0 | 145.23 | 218 | 174 | 145 | 124 | 109 | 97 | 87 | 79 | 73 | 67 | 62 | 58 | 54 | 51 | 48 | 46 | 44 |
| 20″ I | 81.4 | 146.63 | 220 | 176 | 147 | 126 | 110 | 98 | 88 | 80 | 73 | 68 | 63 | 59 | 55 | 52 | 49 | 46 | 44 |
| 14″ C | 95.0 | 147.19 | 165 | 165 | 147 | 126 | 110 | 98 | 88 | 80 | 74 | 68 | 63 | 59 | | | | | |
| 15″ G | 94.0 | 147.32 | 192 | 177 | 147 | 126 | 111 | 98 | 88 | 80 | 74 | 68 | 63 | 59 | 55 | 52 | | | |
| 22″ B | 67.5 | 148.06 | 207 | 178 | 148 | 127 | 111 | 99 | 89 | 81 | 74 | 68 | 63 | 59 | 56 | 52 | 49 | 46 | 44 |
| 20″ B | 73.0 | 148.50 | 206 | 178 | 149 | 127 | 111 | 99 | 89 | 81 | 74 | 69 | 64 | 59 | 56 | 52 | 50 | 47 | 45 |
| 20″ I | 85.0 | 150.17 | 225 | 180 | 150 | 129 | 113 | 100 | 90 | 82 | 75 | 69 | 64 | 60 | 56 | 53 | 50 | 47 | 45 |
| 16″ G | 87.0 | 152.70 | 174 | 174 | 153 | 131 | 115 | 102 | 92 | 83 | 76 | 71 | 65 | 61 | 57 | 54 | 51 | | |
| 15″ G | 99.0 | 154.26 | 203 | 185 | 154 | 132 | 116 | 103 | 93 | 84 | 77 | 71 | 66 | 62 | 58 | 54 | 51 | | |
| 18″ G | 80.0 | 154.44 | 180 | 180 | 154 | 132 | 116 | 103 | 93 | 84 | 77 | 71 | 66 | 62 | 58 | 55 | 51 | 49 | 46 |
| 20″ I | 90.0 | 155.03 | 233 | 186 | 155 | 133 | 116 | 103 | 93 | 85 | 78 | 72 | 66 | 62 | 58 | 55 | 52 | 49 | 47 |
| 16″ C | 90.0 | 157.08 | 193 | 189 | 157 | 135 | 118 | 105 | 94 | 86 | 79 | 73 | 67 | 63 | 59 | 55 | | | |
| 21″ C | 76.0 | 157.60 | 236 | 189 | 158 | 135 | 118 | 105 | 95 | 86 | 79 | 73 | 68 | 63 | 59 | 56 | 53 | 50 | 47 |
| 20″ B | 78.0 | 157.84 | 222 | 189 | 158 | 135 | 118 | 105 | 95 | 86 | 79 | 73 | 68 | 63 | 59 | 56 | 53 | 50 | 47 |
| 20″ I | 95.0 | 159.97 | 240 | 192 | 160 | 137 | 120 | 107 | 96 | 87 | 80 | 74 | 69 | 64 | 60 | 56 | 53 | 50 | 48 |
| 22″ B | 73.0 | 161.50 | 222 | 194 | 162 | 138 | 121 | 108 | 97 | 88 | 81 | 75 | 69 | 65 | 61 | 57 | 54 | 51 | 48 |
| 14″ C | 105 0 | 162.78 | 185 | 185 | 163 | 140 | 122 | 109 | 98 | 89 | 81 | 75 | 70 | 65 | | | | | |
| 24″ C | 70.0 | 162.82 | 230 | 195 | 163 | 140 | 122 | 109 | 98 | 89 | 81 | 75 | 70 | 65 | 61 | 57 | 54 | 51 | 49 |
| 24″ B | 70.0 | 163.66 | 226 | 196 | 164 | 140 | 123 | 109 | 98 | 89 | 82 | 76 | 70 | 66 | 61 | 58 | 55 | 52 | 49 |
| 15″ G | 105.0 | 164.17 | 216 | 197 | 164 | 141 | 123 | 109 | 99 | 90 | 82 | 76 | 70 | 66 | 62 | 58 | 55 | | |
| 20″ I | 100.0 | 164.83 | 247 | 198 | 165 | 141 | 124 | 110 | 99 | 90 | 82 | 76 | 71 | 66 | 62 | 58 | 55 | 52 | 49 |
| 16″ G | 94.0 | 165.10 | 189 | 189 | 165 | 142 | 124 | 110 | 99 | 90 | 83 | 76 | 71 | 66 | 62 | 58 | 55 | | |
| 18″ G | 86.0 | 167.07 | 190 | 190 | 167 | 143 | 125 | 111 | 100 | 91 | 84 | 77 | 72 | 67 | 63 | 59 | 56 | 53 | 50 |
| 18″ C | 86.0 | 168.23 | 185 | 185 | 168 | 144 | 126 | 112 | 101 | 92 | 84 | 78 | 72 | 67 | 63 | 59 | 56 | | |
| 22″ B | 77.0 | 170.63 | 223 | 205 | 171 | 146 | 128 | 114 | 102 | 93 | 85 | 79 | 73 | 68 | 64 | 60 | 57 | 54 | 51 |
| 21″ C | 80.0 | 170.90 | 221 | 205 | 171 | 146 | 128 | 114 | 103 | 93 | 85 | 79 | 73 | 68 | 64 | 60 | 57 | 54 | 51 |
| 24″ I | 79.9 | 173.93 | 261 | 209 | 174 | 149 | 130 | 116 | 104 | 95 | 87 | 80 | 74 | 70 | 65 | 61 | 58 | 55 | 52 |
| 15″ G | 111.0 | 174.51 | 232 | 209 | 175 | 150 | 131 | 116 | 105 | 95 | 87 | 81 | 75 | 70 | 65 | 62 | 58 | | |
| 24″ B | 73.5 | 175.73 | 228 | 211 | 176 | 151 | 132 | 117 | 105 | 96 | 88 | 81 | 75 | 70 | 66 | 62 | 59 | 55 | 53 |
| 16″ C | 100.0 | 178.35 | 178 | 178 | 178 | 153 | 134 | 119 | 107 | 97 | 89 | 82 | 76 | 71 | 67 | 63 | | | |
| 18″ G | 92 0 | 179.75 | 200 | 200 | 180 | 154 | 135 | 120 | 108 | 98 | 90 | 83 | 77 | 72 | 67 | 63 | 60 | 57 | 54 |
| 24″ I | 85 0 | 180 00 | 270 | 216 | 180 | 154 | 135 | 120 | 108 | 98 | 90 | 83 | 77 | 72 | 68 | 63 | 60 | 57 | 54 |
| 18″ C | 93.0 | 181.94 | 201 | 201 | 182 | 156 | 136 | 121 | 109 | 99 | 91 | 84 | 78 | 73 | 68 | 64 | 61 | | |
| 24″ C | 76.0 | 182.03 | 233 | 218 | 182 | 156 | 137 | 121 | 109 | 99 | 91 | 84 | 78 | 73 | 68 | 64 | 61 | 57 | 55 |
| 21″ C | 86.0 | 183.65 | 238 | 220 | 184 | 157 | 138 | 122 | 110 | 100 | 92 | 85 | 79 | 73 | 69 | 65 | 61 | 58 | 55 |
| 22″ B | 83 0 | 184.23 | 240 | 221 | 184 | 158 | 138 | 123 | 111 | 101 | 92 | 85 | 79 | 74 | 69 | 65 | 61 | 58 | 55 |
| 24″ I | 90 0 | 185.84 | 279 | 223 | 186 | 159 | 139 | 124 | 111 | 101 | 93 | 86 | 80 | 74 | 70 | 66 | 62 | 59 | 56 |
| 24″ B | 79.5 | 188.19 | 249 | 226 | 188 | 161 | 141 | 125 | 113 | 103 | 94 | 87 | 81 | 75 | 71 | 66 | 63 | 59 | 56 |
| 16″ C | 107.0 | 190 84 | 192 | 192 | 191 | 164 | 143 | 127 | 114 | 104 | 95 | 88 | 82 | 76 | 72 | 67 | | | |
| 24″ I | 95.0 | 191.80 | 288 | 230 | 192 | 164 | 144 | 128 | 115 | 105 | 96 | 89 | 82 | 77 | 72 | 68 | 64 | 61 | 58 |
| 15″ G | 127.0 | 191.95 | 258 | 230 | 192 | 165 | 144 | 128 | 115 | 105 | 96 | 89 | 82 | 77 | 72 | 68 | | | |
| 18″ G | 99.0 | 193.72 | 212 | 212 | 194 | 166 | 145 | 129 | 116 | 106 | 97 | 89 | 83 | 77 | 73 | 68 | 65 | 61 | 58 |
| 18″ C | 100.0 | 195.57 | 218 | 218 | 196 | 168 | 147 | 130 | 117 | 107 | 98 | 90 | 84 | 78 | 73 | 69 | 65 | | |
| 21″ C | 92.0 | 196.46 | 256 | 236 | 196 | 168 | 147 | 131 | 118 | 107 | 98 | 91 | 84 | 79 | 74 | 69 | 65 | 62 | 59 |
| 24″ I | 100.0 | 197.65 | 296 | 237 | 198 | 169 | 148 | 132 | 119 | 108 | 99 | 91 | 85 | 79 | 74 | 70 | 66 | 62 | 59 |
| 22″ B | 89.0 | 197.88 | 257 | 237 | 198 | 170 | 148 | 132 | 119 | 108 | 99 | 91 | 85 | 79 | 74 | 70 | 66 | 63 | 59 |
| 24″ B | 84.5 | 200.48 | 265 | 241 | 201 | 172 | 150 | 134 | 120 | 109 | 100 | 93 | 86 | 80 | 75 | 71 | 67 | 63 | 60 |
| 26″ B | 81.0 | 201.71 | 272 | 242 | 202 | 173 | 151 | 135 | 121 | 110 | 101 | 93 | 87 | 81 | 76 | 71 | 67 | 64 | 61 |

LOADS BY A. I. S. C. SPECIFICATION

# SUMMARY OF BEAMS FOR VARIOUS UNIFORM LOADS AND SPANS

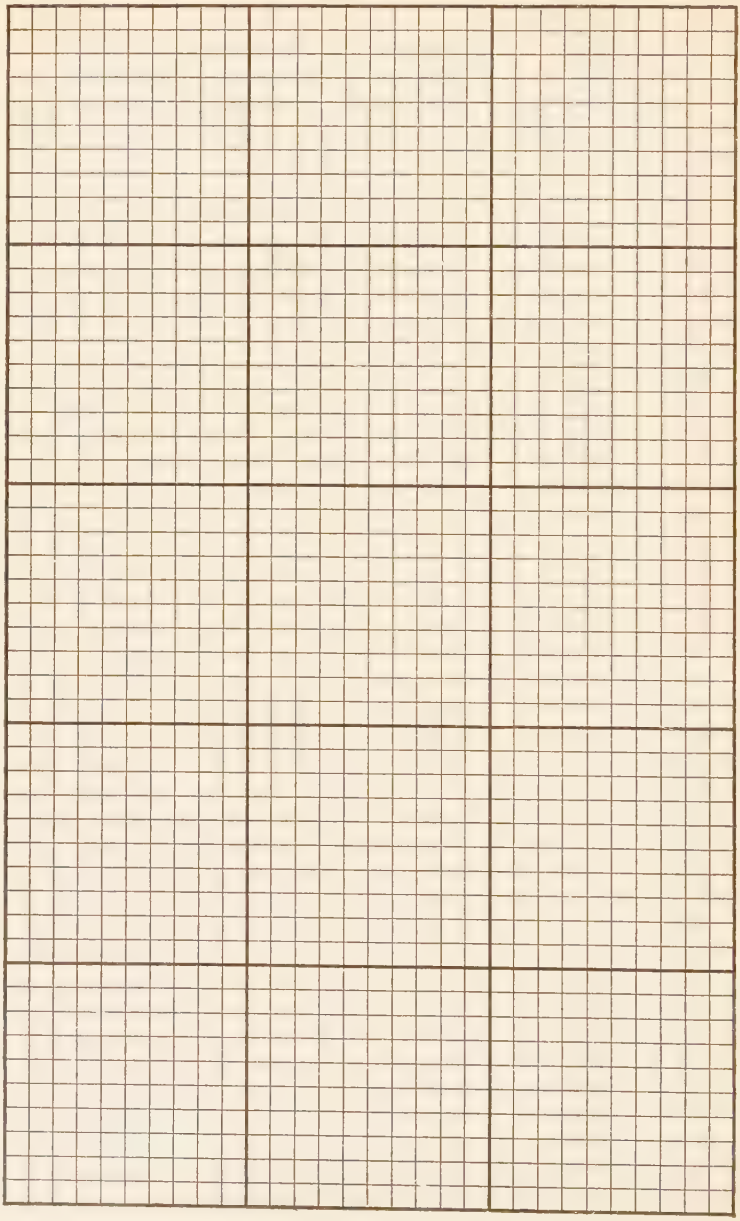
| Size and Kind | Weight per Foot | Section Modulus | SPAN IN FEET—BEAMS LATERALLY FIXED | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 45 | 50 |
| 15″ G | 135.0 | 202.94 | 203 | 174 | 152 | 135 | 122 | 111 | 101 | 94 | 87 | 81 | 76 | 72 | 68 | | | | |
| 24″ C | 85.0 | 203.46 | 203 | 174 | 153 | 136 | 122 | 111 | 102 | 94 | 87 | 81 | 76 | 72 | 68 | 64 | 61 | | |
| 16″ C | 115.0 | 205.17 | 205 | 176 | 154 | 137 | 123 | 112 | 103 | 95 | 88 | 82 | 77 | 72 | | | | | |
| 20″ G | 99.0 | 206.02 | 206 | 177 | 155 | 137 | 124 | 112 | 103 | 95 | 88 | 82 | 77 | 73 | 69 | 65 | 62 | | |
| 21″ C | 98.0 | 209.24 | 209 | 179 | 157 | 139 | 126 | 114 | 105 | 97 | 90 | 84 | 78 | 74 | 70 | 66 | 63 | | |
| 15″ G | 141.0 | 212.91 | 213 | 182 | 160 | 142 | 128 | 116 | 106 | 98 | 91 | 85 | 80 | 75 | 71 | | | | |
| 22″ B | 96.5 | 213.37 | 213 | 183 | 160 | 142 | 128 | 116 | 107 | 99 | 91 | 85 | 80 | 75 | 71 | 67 | 64 | | |
| 26″ B | 85.5 | 214.26 | 214 | 184 | 161 | 143 | 129 | 117 | 107 | 99 | 92 | 86 | 80 | 76 | 72 | 68 | 64 | 57 | |
| 24″ B | 90.5 | 214.61 | 215 | 184 | 161 | 143 | 129 | 117 | 107 | 99 | 92 | 86 | 81 | 76 | 72 | 68 | 64 | | |
| 27″ C | 85.0 | 216.20 | 216 | 185 | 162 | 144 | 130 | 118 | 108 | 100 | 93 | 86 | 81 | 76 | 72 | 68 | 65 | 58 | 52 |
| 20″ G | 107.0 | 221.98 | 222 | 190 | 167 | 148 | 133 | 121 | 111 | 102 | 95 | 89 | 83 | 78 | 74 | 70 | 67 | | |
| 28″ B | 85.0 | 222.12 | 222 | 190 | 167 | 148 | 133 | 121 | 111 | 103 | 95 | 89 | 83 | 78 | 74 | 70 | 67 | 59 | 53 |
| 15″ G | 147.0 | 222.94 | 223 | 191 | 167 | 149 | 134 | 122 | 111 | 103 | 96 | 89 | 84 | 79 | 74 | | | | |
| 24″ C | 94.0 | 225.02 | 225 | 193 | 169 | 150 | 135 | 123 | 113 | 104 | 96 | 90 | 84 | 79 | 75 | 71 | 68 | | |
| 24″ B | 95.5 | 225.24 | 225 | 193 | 169 | 150 | 135 | 123 | 113 | 104 | 97 | 90 | 84 | 79 | 75 | 71 | 68 | | |
| 26″ B | 91.0 | 230.24 | 230 | 197 | 173 | 153 | 138 | 126 | 115 | 106 | 99 | 92 | 86 | 81 | 77 | 73 | 69 | 61 | |
| 24″ I | 105.9 | 234.30 | 234 | 201 | 176 | 156 | 141 | 128 | 117 | 108 | 100 | 94 | 88 | 83 | 78 | 74 | 70 | | |
| 21″ C | 104.0 | 235.74 | 234 | 202 | 177 | 157 | 141 | 129 | 118 | 109 | 101 | 94 | 88 | 83 | 79 | 74 | 71 | | |
| 20″ G | 113.0 | 236.28 | 236 | 203 | 177 | 158 | 142 | 129 | 118 | 109 | 101 | 95 | 89 | 83 | 79 | 75 | 71 | | |
| 22″ G | 101.0 | 236.78 | 236 | 203 | 178 | 158 | 142 | 129 | 118 | 109 | 101 | 95 | 89 | 84 | 79 | 75 | 71 | | |
| 24″ B | 99.5 | 236.78 | 237 | 203 | 178 | 158 | 142 | 129 | 118 | 109 | 101 | 95 | 89 | 84 | 79 | 75 | 71 | | |
| 27″ C | 91.0 | 238.30 | 238 | 204 | 179 | 159 | 143 | 130 | 119 | 110 | 102 | 95 | 89 | 84 | 79 | 75 | 71 | 64 | 57 |
| 24″ I | 110.0 | 239.10 | 239 | 205 | 179 | 159 | 143 | 130 | 120 | 110 | 102 | 96 | 90 | 84 | 80 | 76 | 72 | | |
| 24″ I | 115.0 | 245.04 | 245 | 210 | 184 | 163 | 147 | 134 | 123 | 113 | 105 | 98 | 92 | 86 | 82 | 77 | 74 | | |
| 28″ B | 91.0 | 246.85 | 247 | 212 | 185 | 165 | 148 | 135 | 123 | 114 | 106 | 99 | 93 | 87 | 82 | 78 | 74 | 66 | 59 |
| 26″ B | 98.0 | 247.41 | 247 | 212 | 186 | 165 | 148 | 135 | 124 | 114 | 106 | 99 | 93 | 87 | 82 | 78 | 74 | 66 | |
| 24″ B | 104.5 | 248.84 | 249 | 213 | 187 | 166 | 149 | 136 | 124 | 115 | 107 | 100 | 93 | 88 | 83 | 79 | 75 | | |
| 24″ I | 120.0 | 250.90 | 251 | 215 | 188 | 167 | 151 | 137 | 125 | 116 | 108 | 100 | 94 | 89 | 84 | 79 | 75 | | |
| 20″ G | 120.0 | 251.29 | 251 | 215 | 188 | 168 | 151 | 137 | 126 | 116 | 108 | 100 | 94 | 89 | 84 | 79 | 75 | | |
| 24″ C | 100.0 | 251.71 | 252 | 216 | 189 | 168 | 151 | 137 | 126 | 116 | 108 | 101 | 94 | 89 | 84 | 79 | 76 | 67 | 60 |
| 21″ C | 112.0 | 254.07 | 253 | 218 | 191 | 169 | 152 | 139 | 127 | 117 | 109 | 102 | 95 | 90 | 85 | 80 | 76 | | |
| 22″ G | 108.0 | 254.94 | 253 | 219 | 191 | 170 | 153 | 139 | 128 | 118 | 109 | 102 | 96 | 90 | 85 | 81 | 77 | | |
| 20″ G | 127.0 | 264.03 | 264 | 226 | 198 | 176 | 158 | 144 | 132 | 122 | 113 | 106 | 99 | 93 | 88 | 83 | 79 | | |
| 27″ C | 101.0 | 264.72 | 265 | 227 | 199 | 176 | 159 | 144 | 132 | 122 | 113 | 106 | 99 | 93 | 88 | 84 | 79 | 71 | 64 |
| 28″ B | 97.0 | 265.11 | 265 | 227 | 199 | 177 | 159 | 145 | 133 | 122 | 114 | 106 | 99 | 94 | 88 | 84 | 80 | 71 | 64 |
| 24″ G | 107.0 | 266.87 | 267 | 229 | 200 | 178 | 160 | 146 | 133 | 123 | 114 | 107 | 100 | 94 | 89 | 84 | 80 | 71 | 64 |
| 21″ C | 120.0 | 272.11 | 272 | 233 | 204 | 181 | 163 | 148 | 136 | 126 | 117 | 109 | 102 | 96 | 91 | 86 | 82 | | |
| 22″ G | 116.0 | 273.16 | 271 | 234 | 205 | 182 | 164 | 149 | 137 | 126 | 117 | 109 | 102 | 96 | 91 | 86 | 82 | | |
| 24″ C | 110.0 | 276.83 | 277 | 237 | 208 | 185 | 166 | 151 | 138 | 128 | 119 | 111 | 104 | 98 | 92 | 87 | 83 | 74 | 66 |
| 20″ G | 135.0 | 280.57 | 281 | 240 | 210 | 187 | 168 | 153 | 140 | 130 | 120 | 112 | 105 | 99 | 94 | 89 | 84 | | |
| 24″ G | 113.0 | 281.68 | 282 | 241 | 211 | 188 | 169 | 154 | 141 | 130 | 121 | 113 | 106 | 99 | 94 | 89 | 85 | 75 | 68 |
| 28″ B | 104.0 | 284.73 | 285 | 244 | 214 | 190 | 171 | 155 | 142 | 131 | 122 | 114 | 107 | 100 | 95 | 90 | 85 | 76 | 68 |
| 21″ C | 128.0 | 290.42 | 290 | 249 | 218 | 194 | 174 | 158 | 145 | 134 | 124 | 116 | 109 | 102 | 97 | 92 | 87 | | |
| 27″ C | 112.0 | 293.17 | 293 | 251 | 220 | 195 | 176 | 160 | 147 | 135 | 126 | 117 | 110 | 103 | 98 | 93 | 88 | 78 | 70 |
| 22″ G | 124.0 | 293.19 | 291 | 251 | 220 | 195 | 176 | 160 | 147 | 135 | 126 | 117 | 110 | 104 | 98 | 93 | 88 | | |
| 20″ G | 142.0 | 296.06 | 296 | 254 | 222 | 197 | 178 | 162 | 148 | 137 | 127 | 118 | 111 | 105 | 99 | 94 | 89 | | |
| 24″ G | 120.0 | 300.65 | 301 | 258 | 225 | 200 | 180 | 164 | 150 | 139 | 129 | 120 | 113 | 106 | 100 | 95 | 90 | 80 | 72 |
| 24″ C | 120.0 | 301.91 | 302 | 259 | 226 | 201 | 181 | 165 | 151 | 139 | 129 | 121 | 113 | 107 | 101 | 95 | 91 | 81 | 72 |
| 28″ B | 112.0 | 306.41 | 306 | 263 | 230 | 204 | 184 | 167 | 153 | 141 | 131 | 123 | 115 | 108 | 102 | 97 | 92 | 82 | 74 |
| 21″ C | 136.0 | 308.37 | 308 | 264 | 231 | 206 | 185 | 168 | 154 | 142 | 132 | 123 | 116 | 109 | 103 | 97 | 93 | | |
| 20″ G | 149.0 | 311.62 | 312 | 267 | 234 | 208 | 187 | 170 | 156 | 144 | 134 | 125 | 117 | 110 | 104 | 98 | 93 | | |
| 22″ G | 132.0 | 312.88 | 309 | 268 | 235 | 209 | 188 | 171 | 157 | 144 | 134 | 125 | 117 | 110 | 104 | 99 | 94 | | |
| 30″ B | 110.0 | 314.82 | 315 | 270 | 236 | 210 | 189 | 172 | 157 | 145 | 135 | 126 | 118 | 111 | 105 | 99 | 95 | 84 | 76 |
| 24″ G | 128.0 | 320.66 | 321 | 275 | 240 | 214 | 192 | 175 | 160 | 148 | 137 | 128 | 120 | 113 | 107 | 101 | 96 | 86 | 77 |
| 27″ C | 124.0 | 324.82 | 325 | 278 | 244 | 217 | 195 | 177 | 162 | 150 | 139 | 130 | 122 | 115 | 108 | 103 | 97 | 87 | 78 |
| 28″ B | 119.0 | 327.51 | 328 | 281 | 246 | 218 | 197 | 179 | 164 | 151 | 140 | 131 | 123 | 116 | 109 | 103 | 98 | 87 | 79 |
| 24″ G | 132.0 | 329.95 | 327 | 283 | 247 | 220 | 198 | 180 | 165 | 152 | 141 | 132 | 124 | 116 | 110 | 104 | 99 | 88 | 79 |
| 30″ B | 115.0 | 330.85 | 331 | 284 | 248 | 221 | 198 | 180 | 165 | 153 | 142 | 132 | 124 | 117 | 110 | 104 | 99 | 88 | 79 |
| 30″ C | 115.0 | 332.35 | 332 | 285 | 249 | 222 | 199 | 181 | 166 | 153 | 142 | 133 | 125 | 117 | 111 | 105 | 100 | 89 | 80 |
| 24″ C | 130.0 | 333.62 | 318 | 286 | 250 | 222 | 200 | 182 | 167 | 154 | 143 | 133 | 125 | 118 | 111 | 105 | 100 | 89 | 80 |
| 24″ G | 140.0 | 350.11 | 346 | 300 | 263 | 233 | 210 | 191 | 175 | 162 | 150 | 140 | 131 | 124 | 117 | 111 | 105 | 93 | 84 |
| 30″ B | 121.0 | 351.31 | 351 | 301 | 263 | 234 | 211 | 192 | 176 | 162 | 151 | 141 | 132 | 124 | 117 | 111 | 105 | 94 | 85 |
| 27″ C | 137.0 | 358.73 | 352 | 302 | 264 | 235 | 211 | 192 | 176 | 163 | 151 | 141 | 132 | 124 | 117 | 111 | 106 | 96 | 85 |
| 24″ C | 140.0 | 359.23 | 344 | 308 | 269 | 239 | 216 | 196 | 180 | 166 | 154 | 144 | 135 | 127 | 120 | 113 | 108 | 96 | 86 |
| 30″ C | 126.0 | 363.82 | 364 | 312 | 273 | 243 | 218 | 198 | 182 | 168 | 156 | 145 | 136 | 128 | 121 | 115 | 109 | 97 | 87 |
| 28″ B | 133.0 | 364.04 | 364 | 312 | 273 | 243 | 219 | 199 | 182 | 168 | 156 | 146 | 137 | 129 | 121 | 115 | 109 | 97 | 87 |
| 26″ G | 138.0 | 370.39 | 359 | 317 | 278 | 247 | 222 | 202 | 185 | 171 | 159 | 148 | 139 | 131 | 124 | 117 | 111 | 99 | 89 |
| 24″ G | 148.0 | 371.31 | 370 | 318 | 278 | 248 | 223 | 203 | 186 | 171 | 159 | 149 | 139 | 131 | 124 | 117 | 111 | 99 | 89 |
| 30″ B | 129.0 | 373.35 | 373 | 320 | 280 | 249 | 224 | 204 | 187 | 172 | 160 | 149 | 140 | 132 | 124 | 118 | 112 | 100 | 90 |

LOADS BY A. I. S. C. SPECIFICATION

# SUMMARY OF BEAMS FOR VARIOUS UNIFORM LOADS AND SPANS

| Size and Kind | Weight per Foot | Section Modulus | SPAN IN FEET—BEAMS LATERALLY FIXED | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 45 | 50 |
| 24" C | 150.0 | 384.94 | 370 | 330 | 289 | 257 | 231 | 210 | 192 | 178 | 165 | 154 | 144 | 136 | 128 | 122 | 115 | 103 | 92 |
| 26" G | 144.0 | 385.12 | 379 | 330 | 289 | 257 | 231 | 210 | 193 | 178 | 165 | 154 | 144 | 136 | 128 | 122 | 116 | 103 | 92 |
| 33" C | 125.0 | 394.81 | 395 | 338 | 296 | 263 | 237 | 215 | 197 | 182 | 169 | 158 | 148 | 139 | 132 | 125 | 118 | 105 | 95 |
| 33" B | 125.0 | 395.15 | 395 | 339 | 296 | 263 | 237 | 216 | 198 | 182 | 169 | 158 | 148 | 140 | 132 | 125 | 119 | 105 | 95 |
| 30" B | 137.0 | 398.46 | 398 | 342 | 299 | 266 | 239 | 217 | 199 | 184 | 171 | 159 | 149 | 141 | 133 | 126 | 120 | 106 | 96 |
| 30" C | 138.0 | 398.73 | 399 | 342 | 299 | 266 | 239 | 217 | 199 | 184 | 171 | 159 | 150 | 141 | 133 | 126 | 120 | 106 | 96 |
| 26" G | 151.0 | 406.91 | 393 | 349 | 305 | 271 | 244 | 222 | 203 | 188 | 174 | 163 | 153 | 144 | 136 | 128 | 122 | 109 | 98 |
| 27" C | 145.0 | 408.05 | 376 | 350 | 306 | 272 | 245 | 223 | 204 | 188 | 175 | 163 | 153 | 144 | 136 | 129 | 122 | 109 | 98 |
| 24" C | 160.0 | 410.78 | 397 | 352 | 308 | 274 | 246 | 224 | 205 | 190 | 176 | 164 | 154 | 145 | 137 | 130 | 123 | 110 | 99 |
| 28" G | 145.0 | 416.02 | 390 | 357 | 312 | 277 | 250 | 227 | 208 | 192 | 178 | 166 | 156 | 147 | 139 | 131 | 125 | 111 | 100 |
| 33" B | 135.0 | 422.27 | 422 | 362 | 317 | 282 | 253 | 230 | 211 | 195 | 181 | 169 | 158 | 149 | 141 | 133 | 127 | 113 | 101 |
| 26" G | 160.0 | 431.04 | 420 | 369 | 323 | 287 | 259 | 235 | 215 | 199 | 185 | 172 | 162 | 152 | 144 | 136 | 129 | 115 | 103 |
| 30" B | 149.0 | 434.07 | 434 | 372 | 326 | 289 | 261 | 237 | 217 | 200 | 186 | 174 | 163 | 153 | 145 | 137 | 130 | 116 | 104 |
| 33" C | 138.0 | 435.59 | 436 | 373 | 327 | 290 | 261 | 238 | 218 | 201 | 187 | 174 | 163 | 154 | 145 | 138 | 131 | 116 | 105 |
| 30" C | 151.0 | 436.42 | 436 | 374 | 327 | 291 | 262 | 238 | 218 | 201 | 187 | 175 | 164 | 154 | 145 | 138 | 131 | 116 | 105 |
| 28" G | 156.0 | 446.10 | 425 | 382 | 335 | 297 | 268 | 243 | 223 | 206 | 191 | 178 | 167 | 157 | 149 | 141 | 134 | 119 | 107 |
| 33" B | 143.0 | 449.41 | 449 | 385 | 337 | 300 | 279 | 245 | 225 | 207 | 193 | 180 | 169 | 159 | 150 | 142 | 135 | 120 | 108 |
| 27" C | 160.0 | 450.13 | 417 | 386 | 338 | 300 | 270 | 246 | 225 | 208 | 193 | 180 | 169 | 159 | 150 | 142 | 135 | 120 | 108 |
| 28" G | 165.0 | 473.19 | 454 | 406 | 355 | 315 | 284 | 258 | 237 | 218 | 203 | 189 | 177 | 167 | 158 | 149 | 142 | 126 | 114 |
| 30" B | 163.0 | 474.43 | 474 | 407 | 356 | 316 | 285 | 259 | 237 | 219 | 203 | 190 | 178 | 167 | 158 | 150 | 142 | 127 | 114 |
| 30" C | 165.0 | 476.66 | 477 | 409 | 358 | 318 | 286 | 260 | 238 | 220 | 204 | 191 | 179 | 168 | 159 | 151 | 143 | 127 | 114 |
| 33" C | 152.0 | 479.79 | 480 | 411 | 360 | 320 | 288 | 262 | 240 | 221 | 206 | 192 | 180 | 169 | 160 | 152 | 144 | 128 | 115 |
| 33" B | 152.0 | 480.40 | 480 | 412 | 360 | 320 | 288 | 262 | 240 | 222 | 206 | 192 | 180 | 170 | 160 | 152 | 144 | 128 | 115 |
| 27" C | 175.0 | 492.47 | 459 | 422 | 369 | 328 | 295 | 269 | 246 | 227 | 211 | 197 | 185 | 174 | 164 | 156 | 148 | 131 | 118 |
| 28" G | 175.0 | 499.72 | 479 | 428 | 375 | 333 | 300 | 273 | 250 | 231 | 214 | 200 | 187 | 176 | 167 | 158 | 150 | 133 | 120 |
| 36" C | 147.0 | 502.24 | 502 | 430 | 377 | 335 | 301 | 274 | 251 | 232 | 215 | 201 | 188 | 177 | 167 | 159 | 151 | 134 | 121 |
| 36" B | 147.0 | 503 42 | 502 | 432 | 378 | 336 | 302 | 275 | 252 | 232 | 216 | 201 | 189 | 178 | 168 | 159 | 151 | 134 | 121 |
| 33" C | 167.0 | 527.06 | 527 | 452 | 395 | 351 | 316 | 288 | 264 | 243 | 226 | 211 | 198 | 186 | 176 | 166 | 158 | 141 | 127 |
| 33" B | 165.0 | 527.49 | 527 | 452 | 396 | 352 | 317 | 288 | 264 | 244 | 226 | 211 | 198 | 186 | 176 | 167 | 158 | 141 | 127 |
| 30" G | 173.0 | 528.46 | 473 | 453 | 396 | 352 | 317 | 288 | 264 | 244 | 226 | 211 | 198 | 187 | 176 | 167 | 159 | 141 | 127 |
| 36" B | 155.0 | 530.41 | 530 | 455 | 398 | 354 | 318 | 289 | 265 | 245 | 227 | 212 | 199 | 187 | 177 | 167 | 159 | 141 | 127 |
| 27" C | 190.0 | 534.60 | 501 | 458 | 401 | 356 | 321 | 292 | 267 | 247 | 229 | 214 | 200 | 189 | 178 | 169 | 160 | 143 | 128 |
| 28" G | 186.0 | 537.19 | 496 | 460 | 402 | 358 | 322 | 293 | 269 | 248 | 230 | 215 | 201 | 190 | 179 | 170 | 161 | 143 | 128 |
| 36" C | 160.0 | 549.05 | 549 | 471 | 412 | 366 | 329 | 300 | 275 | 253 | 235 | 220 | 206 | 194 | 183 | 173 | 165 | 146 | 132 |
| 30" C | 180.0 | 553.43 | 482 | 474 | 415 | 369 | 332 | 302 | 277 | 255 | 237 | 221 | 208 | 195 | 184 | 175 | 166 | 148 | 133 |
| 30" G | 180.0 | 556.21 | 490 | 477 | 417 | 371 | 334 | 303 | 278 | 257 | 238 | 222 | 209 | 196 | 185 | 176 | 167 | 148 | 133 |
| 36" B | 164.0 | 561.07 | 559 | 481 | 421 | 374 | 337 | 306 | 281 | 259 | 240 | 224 | 210 | 198 | 187 | 177 | 168 | 150 | 135 |
| 30" G | 190.0 | 585.52 | 513 | 502 | 439 | 390 | 351 | 319 | 293 | 270 | 251 | 234 | 220 | 207 | 195 | 185 | 176 | 156 | 141 |
| 36" B | 173.0 | 594.98 | 592 | 510 | 446 | 397 | 357 | 325 | 297 | 275 | 255 | 238 | 223 | 210 | 198 | 188 | 178 | 159 | 143 |
| 36" C | 175.0 | 603.31 | 599 | 517 | 452 | 402 | 362 | 329 | 302 | 278 | 259 | 241 | 226 | 213 | 201 | 191 | 181 | 161 | 145 |
| 30" C | 200.0 | 614.99 | 540 | 527 | 461 | 410 | 369 | 335 | 307 | 284 | 264 | 246 | 231 | 217 | 205 | 194 | 184 | 164 | 148 |
| 30" G | 200.0 | 617.77 | 541 | 530 | 463 | 412 | 371 | 337 | 309 | 285 | 265 | 247 | 232 | 218 | 206 | 195 | 185 | 165 | 148 |
| 36" B | 190.0 | 659.86 | 636 | 566 | 495 | 440 | 396 | 360 | 330 | 305 | 283 | 264 | 247 | 233 | 220 | 208 | 198 | 176 | 158 |
| 36" C | 192.0 | 666.31 | 651 | 571 | 500 | 444 | 400 | 363 | 333 | 308 | 286 | 267 | 250 | 235 | 222 | 210 | 200 | 178 | 160 |
| 33" C | 200.0 | 669.67 | 570 | 570 | 502 | 446 | 402 | 365 | 335 | 309 | 287 | 268 | 251 | 236 | 223 | 211 | 201 | 179 | 161 |
| 33" G | 200.0 | 672.45 | 552 | 552 | 504 | 448 | 403 | 367 | 336 | 310 | 288 | 269 | 252 | 237 | 224 | 212 | 202 | 179 | 161 |
| 30" C | 220.0 | 676.26 | 598 | 580 | 507 | 451 | 406 | 369 | 338 | 312 | 290 | 271 | 254 | 239 | 225 | 214 | 203 | 180 | 162 |
| 30" G | 220.0 | 680 52 | 597 | 583 | 510 | 454 | 408 | 371 | 340 | 314 | 292 | 272 | 255 | 240 | 227 | 215 | 204 | 181 | 163 |
| 33" G | 210.0 | 707.33 | 582 | 582 | 531 | 472 | 424 | 386 | 354 | 326 | 303 | 283 | 265 | 250 | 236 | 223 | 212 | 189 | 170 |
| 30" C | 240.0 | 737.86 | 656 | 632 | 553 | 492 | 443 | 402 | 369 | 341 | 316 | 295 | 277 | 260 | 246 | 233 | 221 | 197 | 177 |
| 33" G | 220.0 | 741 43 | 608 | 608 | 556 | 494 | 445 | 404 | 371 | 342 | 318 | 297 | 278 | 262 | 247 | 234 | 222 | 198 | 178 |
| 30" G | 240.0 | 742.95 | 649 | 636 | 557 | 495 | 446 | 405 | 372 | 343 | 318 | 297 | 279 | 262 | 248 | 235 | 223 | 198 | 178 |
| 33" C | 220 0 | 744.50 | 612 | 612 | 558 | 496 | 447 | 406 | 372 | 344 | 319 | 298 | 279 | 263 | 248 | 235 | 223 | 199 | 179 |
| 33" G | 230 0 | 778.05 | 634 | 634 | 584 | 519 | 467 | 424 | 389 | 359 | 333 | 311 | 292 | 275 | 259 | 246 | 233 | 207 | 187 |
| 33" C | 240.0 | 819.81 | 652 | 652 | 615 | 547 | 492 | 447 | 410 | 378 | 351 | 328 | 307 | 289 | 273 | 259 | 246 | 219 | 197 |
| 33" G | 245.0 | 831.04 | 670 | 670 | 623 | 554 | 499 | 453 | 416 | 384 | 356 | 332 | 312 | 293 | 277 | 262 | 249 | 221 | 199 |
| 36" G | 230.0 | 833.89 | 659 | 659 | 625 | 556 | 500 | 455 | 417 | 385 | 358 | 334 | 313 | 294 | 278 | 263 | 250 | 222 | 200 |
| 36" C | 230.0 | 834.05 | 664 | 664 | 626 | 556 | 500 | 455 | 417 | 385 | 358 | 334 | 313 | 294 | 278 | 263 | 250 | 222 | 200 |
| 36" G | 240 0 | 872.00 | 683 | 683 | 654 | 581 | 523 | 476 | 436 | 402 | 374 | 349 | 327 | 308 | 291 | 275 | 262 | 233 | 209 |
| 33" G | 260.0 | 884.21 | 706 | 706 | 663 | 589 | 531 | 482 | 442 | 408 | 379 | 354 | 332 | 312 | 295 | 279 | 265 | 236 | 212 |
| 33" C | 260.0 | 890.17 | 705 | 705 | 668 | 593 | 534 | 486 | 445 | 411 | 382 | 356 | 334 | 314 | 297 | 281 | 267 | 237 | 214 |
| 36" C | 250.0 | 910.48 | 717 | 717 | 683 | 607 | 546 | 497 | 455 | 420 | 390 | 364 | 341 | 321 | 304 | 288 | 273 | 243 | 219 |
| 36" G | 250.0 | 911.24 | 711 | 711 | 683 | 607 | 547 | 497 | 455 | 420 | 390 | 364 | 342 | 322 | 304 | 288 | 273 | 243 | 219 |
| 36" G | 260.0 | 949.50 | 735 | 735 | 712 | 633 | 570 | 518 | 475 | 438 | 407 | 380 | 356 | 335 | 316 | 300 | 285 | 253 | 228 |
| 36" C | 275.0 | 1006.85 | 781 | 781 | 755 | 671 | 604 | 549 | 503 | 465 | 431 | 403 | 378 | 355 | 336 | 318 | 302 | 268 | 242 |
| 36" G | 280.0 | 1030.74 | 780 | 780 | 773 | 687 | 618 | 562 | 515 | 476 | 442 | 412 | 387 | 364 | 344 | 326 | 309 | 275 | 247 |
| 36" C | 300 0 | 1102.69 | 847 | 847 | 827 | 735 | 662 | 601 | 551 | 509 | 473 | 441 | 414 | 389 | 368 | 348 | 331 | 294 | 265 |
| 36" G | 300.0 | 1103.59 | 833 | 833 | 828 | 736 | 662 | 602 | 552 | 509 | 473 | 441 | 414 | 389 | 368 | 348 | 331 | 294 | 265 |

## NOTES and DIAGRAMS



# Part IV

# Section 10

## American Standard Beams as Columns

**Dimensions**

**Technical Functions**

**Allowable Concentric Loads**

**by**

**A. I. S. C. Specification**

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 3" TO 8" ROLLED COLUMNS

AMERICAN STANDARD BEAMS

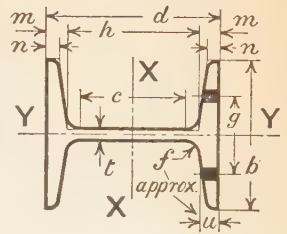
| Weight per foot | Area Sq In | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| **3" AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | |
| 5.7 | 1.64 | 0.53 | 23.5 | 20.3 | 17.2 | 14.6 | 12.3 | 10.5 | | | | | | | |
| 6.5 | 1.88 | 0.52 | 26.7 | 23.0 | 19.5 | 16.4 | 13.8 | 11.7 | | | | | | | |
| 7.5 | 2.17 | 0.52 | 30.9 | 26.5 | 22.5 | 18.9 | 15.9 | 13.5 | | | | | | | |
| **4" AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | |
| 7.7 | 2.21 | 0.59 | 33.0 | 29.1 | 25.3 | 21.8 | 18.7 | 16.1 | 13.9 | | | | | | |
| 8.5 | 2.46 | 0.58 | 36.5 | 32.1 | 27.8 | 23.9 | 20.4 | 17.6 | 15.1 | | | | | | |
| 9.5 | 2.76 | 0.58 | 40.9 | 36.0 | 31.2 | 26.8 | 22.9 | 19.7 | 17.0 | | | | | | |
| 10.5 | 3.05 | 0.57 | 44.9 | 39.4 | 34.0 | 29.1 | 24.9 | 21.3 | 18.3 | | | | | | |
| **5" AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | |
| 10.0 | 2.87 | 0.65 | 43.1 | 39.7 | 35.1 | 30.7 | 26.8 | 23.4 | 20.4 | 17.9 | | | | | |
| 12.25 | 3.56 | 0.63 | 53.4 | 48.5 | 42.6 | 37.1 | 32.2 | 28.0 | 24.4 | 21.3 | | | | | |
| 14.75 | 4.29 | 0.63 | 64.4 | 58.4 | 51.4 | 44.7 | 38.8 | 33.7 | 29.3 | 25.6 | | | | | |
| **6" AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | |
| 12.5 | 3.61 | 0.72 | 54.2 | 52.1 | 46.9 | 41.8 | 37.0 | 32.7 | 28.9 | 25.6 | 22.7 | 20.1 | | | |
| 14.75 | 4.29 | 0.69 | 64.4 | 60.8 | 54.4 | 48.1 | 42.3 | 37.2 | 32.7 | 28.8 | 25.5 | | | | |
| 17.25 | 5.02 | 0.68 | 75.3 | 70.8 | 63.1 | 55.7 | 48.9 | 42.9 | 37.7 | 33.1 | 29.2 | | | | |
| **7" AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | |
| 15.3 | 4.43 | 0.78 | 66.5 | 65.9 | 60.0 | 54.1 | 48.5 | 43.3 | 38.6 | 34.4 | 30.8 | 27.6 | 24.7 | | |
| 17.5 | 5.09 | 0.76 | 76.4 | 75.0 | 68.1 | 61.1 | 54.6 | 48.6 | 43.2 | 38.4 | 34.3 | 30.6 | | | |
| 20.0 | 5.83 | 0.74 | 87.5 | 85.1 | 76.9 | 68.8 | 61.2 | 54.3 | 48.1 | 42.7 | 38.0 | 33.8 | | | |
| **8" AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | |
| 18.4 | 5.34 | 0.84 | 80.1 | 80.1 | 74.9 | 68.2 | 61.8 | 55.7 | 50.1 | 45.0 | 40.5 | 36.5 | 32.9 | 29.6 | |
| 20.5 | 5.97 | 0.82 | 89.6 | 80.6 | 82.8 | 75.2 | 67.9 | 61.0 | 54.7 | 49.1 | 44.1 | 39.6 | 35.7 | | |
| 23.0 | 6.71 | 0.81 | 100.6 | 100.6 | 92.5 | 83.9 | 75.6 | 67.8 | 60.8 | 54.4 | 48.8 | 43.8 | 39.5 | | |
| 25.5 | 7.43 | 0.80 | 111.5 | 111.2 | 101.9 | 92.2 | 82.9 | 74.3 | 66.4 | 59.4 | 53.2 | 47.8 | 42.9 | | |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 3″ TO 8″ ROLLED COLUMNS

AMERICAN STANDARD BEAMS

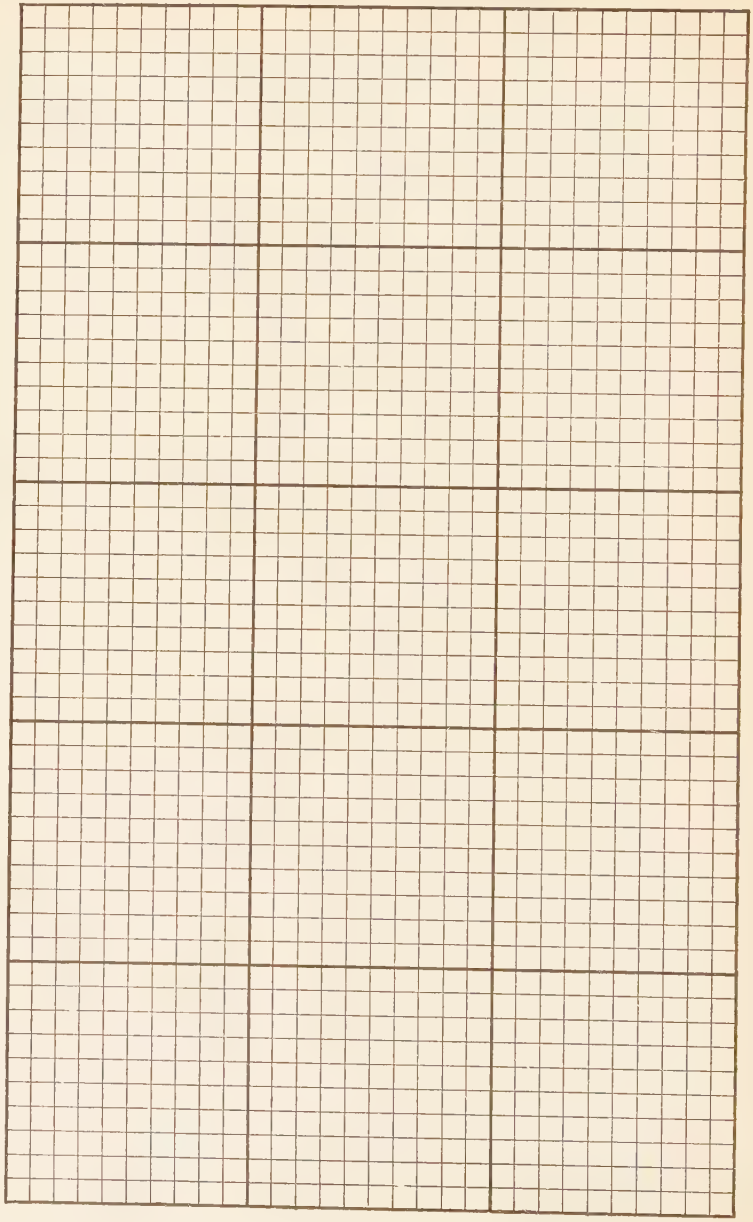
| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **3″ AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | | | |
| 5.7 | 3.000 | 2.33 | .170 | 2.300 | .350 | .170 | .27 | 1.843 | 1½ | 5/16 | 3/8 | 2.5 | 1.67 | 1.23 | 0.46 | 0.40 | 0.53 |
| 6.5 | 3.000 | 2.41 | .251 | 2.300 | .350 | .170 | .27 | 1.843 | 1½ | 5/16 | 3/8 | 2.7 | 1.80 | 1.19 | 0.51 | 0.43 | 0.52 |
| 7.5 | 3.000 | 2.51 | .349 | 2.300 | .350 | .170 | .27 | 1.843 | 1½ | 5/16 | 3/8 | 2.9 | 1.93 | 1.15 | 0.59 | 0.47 | 0.52 |
| **4″ AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | | | |
| 7.7 | 4.000 | 2.66 | .190 | 3.208 | .396 | .190 | .29 | 2.717 | 1½ | 5/16 | ½ | 6.0 | 3.00 | 1.64 | 0.77 | 0.58 | 0.59 |
| 8.5 | 4.000 | 2.72 | .253 | 3.208 | .396 | .190 | .29 | 2.717 | 1½ | 5/16 | ½ | 6.3 | 3.15 | 1.60 | 0.83 | 0.61 | 0.58 |
| 9.5 | 4.000 | 2.80 | .326 | 3.208 | .396 | .190 | .29 | 2.717 | 1½ | 5/16 | ½ | 6.7 | 3.35 | 1.56 | 0.91 | 0.65 | 0.58 |
| 10.5 | 4.000 | 2.87 | .400 | 3.208 | .396 | .190 | .29 | 2.717 | 1½ | 5/16 | ½ | 7.1 | 3.55 | 1.52 | 1.00 | 0.70 | 0.57 |
| **5″ AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | | | |
| 10.0 | 5.000 | 3.00 | .210 | 4.114 | .443 | .210 | .31 | 3.589 | 1¾ | 3/8 | ½ | 12.1 | 4.84 | 2.05 | 1.2 | 0.82 | 0.65 |
| 12.25 | 5.000 | 3.14 | .347 | 4.114 | .443 | .210 | .31 | 3.589 | 1¾ | 3/8 | ½ | 13.5 | 5.40 | 1.95 | 1.4 | 0.91 | 0.63 |
| 14.75 | 5.000 | 3.28 | .494 | 4.114 | .443 | .210 | .31 | 3.589 | 1¾ | 3/8 | ½ | 15.0 | 6.00 | 1.87 | 1.7 | 1.00 | 0.63 |
| **6″ AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | | | |
| 12.5 | 6.000 | 3.33 | .230 | 5.024 | .488 | .230 | .33 | 4.465 | 2″ | 3/8 | 5/8 | 21.8 | 7.27 | 2.46 | 1.8 | 1.1 | 0.72 |
| 14.75 | 6.000 | 3.44 | .343 | 5.024 | .488 | .230 | .33 | 4.465 | 2″ | 3/8 | 5/8 | 23.8 | 7.93 | 2.36 | 2.1 | 1.2 | 0.69 |
| 17.25 | 6.000 | 3.57 | .465 | 5.024 | .488 | .230 | .33 | 4.465 | 2″ | 3/8 | 5/8 | 26.0 | 8.67 | 2.28 | 2.3 | 1.3 | 0.68 |
| **7″ AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | | | |
| 15.3 | 7.000 | 3.66 | .250 | 5.936 | .534 | .250 | .35 | 5.339 | 2¼ | 3/8 | 5/8 | 36.2 | 10.34 | 2.86 | 2.7 | 1.5 | 0.78 |
| 17.5 | 7.000 | 3.76 | .345 | 5.936 | .534 | .250 | .35 | 5.339 | 2¼ | 3/8 | 5/8 | 38.9 | 11.11 | 2.77 | 2.9 | 1.6 | 0.76 |
| 20.0 | 7.000 | 3.86 | .450 | 5.936 | .534 | .250 | .35 | 5.339 | 2¼ | 3/8 | 5/8 | 41.9 | 11.97 | 2.68 | 3.1 | 1.6 | 0.74 |
| **8″ AMERICAN STANDARD BEAMS** | | | | | | | | | | | | | | | | | |
| 18.4 | 8.000 | 4.00 | .270 | 6.838 | .581 | .270 | .37 | 6.211 | 2¼ | 7/16 | ¾ | 56.9 | 14.22 | 3.26 | 3.8 | 1.9 | 0.84 |
| 20.5 | 8.000 | 4.08 | .349 | 6.838 | .581 | .270 | .37 | 6.211 | 2¼ | 7/16 | ¾ | 60.2 | 15.05 | 3.18 | 4.0 | 2.0 | 0.82 |
| 23.0 | 8.000 | 4.17 | .441 | 6.838 | .581 | .270 | .37 | 6.211 | 2¼ | 7/16 | ¾ | 64.2 | 16.05 | 3.09 | 4.4 | 2.1 | 0.81 |
| 25.5 | 8.000 | 4.26 | .532 | 6.838 | .581 | .270 | .37 | 6.211 | 2¼ | ½ | ¾ | 68.1 | 17.02 | 3.03 | 4.7 | 2.2 | 0.80 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

3″ to 8″

## NOTES and DIAGRAMS



# Part IV

# Section 11

## BETHLEHEM COLUMN SECTIONS

## BETHLEHEM COLUMN SECTIONS WITH COVER PLATES

### Dimensions—Technical Functions

### Allowable Concentric Loads by A. I. S. C. Specification

| Manufacturers Section Index | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sec. Index | Depth | Weight | | | | | | | | | |
| BS 6 | 6″ | 15.5 | 18.0 | | | | | | | | |
| H 6 | 6″ | 20.0 | 23.0 | 26.5 | 30.0 | 33.5 | 37.0 | 40.5 | | | |
| H 6/10 | 6″ | 40.0 | 46.0 | 53.0 | 60.0 | 67.0 | 73.0 | 80.0 | 88.0 | | |
| H 8/6.5 | 8″ | 23.5 | 27.0 | 30.5 | 34.5 | | | | | | |
| H 8 | 8″ | 32.0 | 35.0 | 39.5 | 44 0 | 48.5 | 53 0 | 58.0 | 62.5 | 67.5 | 72 0 |
| | | 77.0 | 81.5 | 86.0 | 91.0 | | | | | | |
| H 10/8 | 10″ | 33.5 | 38.0 | 42.5 | 47.5 | | | | | | |
| H 10 | 10″ | 49.5 | 55.0 | 60.5 | 66 0 | 72.0 | 77.5 | 83.5 | 89 0 | 95.0 | 100.5 |
| | | 106.5 | 112.0 | 118.0 | 124.0 | 130.0 | 136.5 | | | | |
| H 10/12 | 10″ | 62.0 | 68.0 | 75.0 | 82.0 | 88.0 | 94.0 | 100.0 | 107.0 | 113.0 | 125 0 |
| | | 133.0 | 140.0 | 148.0 | 155.0 | 162.0 | 170.0 | 177.0 | 185.0 | 192.0 | 200.0 |
| | | 208.0 | 215.0 | 222.0 | 230 0 | 238.0 | 246 0 | | | | |
| H 12/8 | 12″ | 40.5 | 45.5 | 50.5 | 55.0 | | | | | | |
| H 12/10 | 12″ | 52 5 | 58 0 | 64 0 | 70 0 | | | | | | |
| H 12 | 12″ | 65.5 | 72.5 | 79 0 | 85 5 | 92.5 | 99 5 | 106 0 | 113.0 | 119 5 | 126 5 |
| | | 133.5 | 140 5 | 147.5 | 154 5 | 162 0 | 169.0 | 176.0 | 183 0 | 190.0 | |
| H 14/8 | 14″ | 43.0 | 48 0 | 53 5 | 58 5 | | | | | | |
| H 14/10 | 14″ | 55 0 | 61.5 | 67.5 | 73 5 | | | | | | |
| H 14/12 | 14″ | 69.0 | 76.0 | 83.0 | 90.0 | | | | | | |
| H 14 | 14″ | 84.0 | 92.0 | 100.0 | 107.5 | 115.5 | 123.5 | 131.5 | 139 0 | 147.0 | 155.0 |
| | | 161 0 | 168.0 | 177 0 | 185.0 | 194.0 | 202 0 | 210 0 | 219 0 | 227 0 | 236 0 |
| | | 245.0 | 254.0 | 262.0 | 271.0 | 280.0 | 289.0 | 298.0 | | | |
| H 14b | 14″ | 149.0 | | | | | | | | | |
| H 16 | 16″ | 143.0 | 151.0 | 160.0 | 169.0 | 177.0 | 186.0 | 195.0 | 203.0 | 212 0 | 221 0 |
| | | 230 0 | 238.0 | 247.0 | 256.0 | 265.0 | 274.0 | 288 0 | 301 0 | 314 0 | 328.0 |
| | | 342.0 | 356.0 | 370.0 | 384.0 | 399.0 | 413.0 | 427.0 | | | |

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 6″ ROLLED COLUMNS

BETHLEHEM SECTIONS

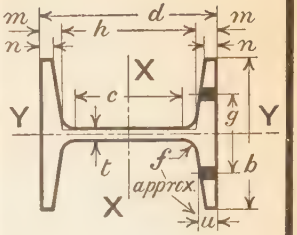
| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 |
| **6″ BETHLEHEM STANCHIONS.** | | | | | | | | | | | | | | | | | | | | | | |
| 15 5 | 4 61 | 1 41 | 69 | 69 | 66 | 63 | 59 | 56 | 53 | 49 | 46 | 44 | 41 | 38 | 36 | | | | | | | |
| 18 0 | 5 33 | 1 43 | 80 | 80 | 77 | 73 | 69 | 65 | 61 | 58 | 54 | 51 | 48 | 45 | 42 | | | | | | | |
| **6″ BETHLEHEM H COLUMNS.** | | | | | | | | | | | | | | | | | | | | | | |
| 20 0 | 5 89 | 1.49 | 88 | 88 | 86 | 82 | 78 | 74 | 70 | 66 | 62 | 59 | 55 | 52 | 49 | 46 | 43 | 39 | 35 | | | |
| 23 0 | 6 76 | 1.51 | 101 | 101 | 99 | 95 | 90 | 85 | 81 | 76 | 72 | 68 | 64 | 60 | 57 | 54 | 51 | 45 | 40 | | | |
| 26 5 | 7 76 | 1 53 | 116 | 116 | 115 | 109 | 104 | 99 | 94 | 89 | 84 | 79 | 74 | 70 | 66 | 63 | 59 | 53 | 47 | | | |
| 30 0 | 8 77 | 1 54 | 132 | 132 | 130 | 124 | 118 | 112 | 106 | 101 | 95 | 90 | 85 | 80 | 75 | 71 | 67 | 60 | 54 | | | |
| 33.5 | 9 80 | 1.55 | 147 | 147 | 145 | 139 | 132 | 126 | 119 | 113 | 107 | 101 | 95 | 90 | 85 | 80 | 76 | 67 | 60 | | | |
| 37 0 | 10 83 | 1.57 | 162 | 162 | 161 | 154 | 147 | 140 | 133 | 126 | 119 | 113 | 106 | 101 | 95 | 90 | 85 | 76 | 68 | | | |
| 40 5 | 11 87 | 1 58 | 178 | 178 | 177 | 170 | 162 | 154 | 146 | 139 | 131 | 124 | 117 | 111 | 105 | 99 | 94 | 84 | 75 | | | |
| **6″/10 BETHLEHEM HEAVY WEIGHT STANCHIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 40.0 | 11.71 | 2.46 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 172 | 167 | 162 | 157 | 152 | 148 | 143 | 138 | 129 | 120 | 111 | 104 | 96 |
| 46.0 | 13.54 | 2.49 | 203 | 203 | 203 | 203 | 203 | 203 | 203 | 200 | 195 | 189 | 183 | 177 | 172 | 168 | 161 | 150 | 140 | 130 | 121 | 113 |
| 53.0 | 15.59 | 2.52 | 234 | 234 | 234 | 234 | 234 | 234 | 234 | 231 | 225 | 219 | 212 | 206 | 199 | 193 | 187 | 174 | 163 | 152 | 141 | 131 |
| 60.0 | 17.65 | 2.55 | 265 | 265 | 265 | 265 | 265 | 265 | 265 | 263 | 256 | 249 | 243 | 234 | 227 | 220 | 213 | 199 | 186 | 173 | 162 | 151 |
| 67.0 | 19.70 | 2.58 | 296 | 296 | 296 | 296 | 296 | 296 | 296 | 295 | 287 | 279 | 271 | 263 | 255 | 247 | 240 | 224 | 210 | 196 | 183 | 170 |
| 73.0 | 21.47 | 2.60 | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 314 | 305 | 297 | 288 | 279 | 271 | 262 | 246 | 230 | 215 | 201 | 187 |
| 80.0 | 23.53 | 2 62 | 353 | 353 | 353 | 353 | 353 | 353 | 353 | 353 | 345 | 336 | 326 | 317 | 308 | 298 | 289 | 271 | 253 | 237 | 221 | 207 |
| 88.0 | 25.89 | 2.65 | 388 | 388 | 388 | 388 | 388 | 388 | 388 | 388 | 381 | 371 | 361 | 351 | 340 | 330 | 320 | 300 | 281 | 263 | 246 | 230 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 6″ ROLLED COLUMNS

BETHLEHEM SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **6″ BETHLEHEM STANCHIONS** | | | | | | | | | | | | | | | | | |
| 15.5 | 6.000 | 6.00 | .240 | 5.404 | .298 | .240 | .30 | 4.813 | 3½ | 9/32 | ¾ | 30.3 | 10.10 | 2 56 | 9.19 | 3.06 | 1.41 |
| 18.0 | 6.094 | 6.03 | .270 | 5.404 | .343 | .285 | .30 | 4.813 | 3½ | 5/16 | ¾ | 35.8 | 11.75 | 2.59 | 11.0 | 3.64 | 1.43 |
| **6″ BETHLEHEM H COLUMNS** | | | | | | | | | | | | | | | | | |
| 20.0 | 6.000 | 6.000 | .250 | 5.193 | .404 | .346 | .30 | 4.625 | 3½ | 3/8 | ¾ | 39.1 | 13.03 | 2.58 | 13.0 | 4.34 | 1.49 |
| 23.0 | 6.125 | 6.020 | .270 | 5.193 | .466 | .409 | .30 | 4.625 | 3½ | 7/16 | ¾ | 46.4 | 15.15 | 2.62 | 15.4 | 5.12 | 1.51 |
| 26.5 | 6.250 | 6.060 | .310 | 5.193 | .529 | .471 | .30 | 4.625 | 3½ | ½ | ¾ | 54.4 | 17.41 | 2.65 | 18.1 | 5.96 | 1.53 |
| 30.0 | 6.375 | 6.100 | .350 | 5.193 | .591 | .534 | .30 | 4 625 | 3½ | 9/16 | ¾ | 62.8 | 19.70 | 2.68 | 20.8 | 6.82 | 1.54 |
| 33.5 | 6.500 | 6.140 | .390 | 5 193 | .654 | .596 | .30 | 4.625 | 3½ | 5/8 | ¾ | 71.6 | 22.03 | 2.70 | 23.6 | 7.70 | 1.55 |
| 37.0 | 6.625 | 6.180 | .430 | 5.193 | .716 | .659 | .30 | 4.625 | 3½ | 11/16 | ¾ | 80 9 | 24.42 | 2.73 | 26.6 | 8.60 | 1.57 |
| 40.5 | 6.750 | 6.220 | .470 | 5.193 | .779 | .721 | .30 | 4.625 | 3½ | ¾ | ¾ | 90.5 | 26.81 | 2.76 | 29.6 | 9.52 | 1.58 |
| **6″/10 BETHLEHEM HEAVY WEIGHT STANCHIONS** | | | | | | | | | | | | | | | | | |
| 40.0 | 6.216 | 9.875 | .465 | 5.192 | .512 | .418 | .30 | 4.625 | 5½ | 15/32 | ¾ | 82.3 | 26.48 | 2.65 | 71.1 | 14 4 | 2.46 |
| 46.0 | 6.356 | 9.944 | .534 | 5.192 | .582 | .488 | .30 | 4 625 | 5½ | 17/32 | ¾ | 97.4 | 30 65 | 2.68 | 84.1 | 16.9 | 2.49 |
| 53.0 | 6.512 | 10.022 | .612 | 5.192 | .660 | .566 | .30 | 4.625 | 5½ | 5/8 | ¾ | 115.2 | 35.38 | 2.72 | 99.3 | 19.8 | 2.52 |
| 60.0 | 6.666 | 10.099 | .689 | 5.192 | .737 | .643 | .30 | 4.625 | 5½ | 11/16 | ¾ | 133.9 | 40.17 | 2.75 | 114.9 | 22.7 | 2.55 |
| 67.0 | 6.818 | 10.175 | .765 | 5.192 | .813 | .719 | .30 | 4.625 | 5½ | ¾ | ¾ | 153.3 | 44.97 | 2.79 | 130.9 | 25.7 | 2.58 |
| 73.0 | 6.946 | 10.241 | .831 | 5.192 | .877 | .783 | .30 | 4.625 | 5½ | 27/32 | ¾ | 170.6 | 49.12 | 2.82 | 145.0 | 28.3 | 2.60 |
| 80.0 | 7.096 | 10.315 | .905 | 5.192 | .952 | .858 | .30 | 4.625 | 5½ | 29/32 | ¾ | 191.7 | 54 03 | 2.85 | 162.0 | 31.4 | 2.62 |
| 88.0 | 7.265 | 10.400 | .990 | 5.192 | 1.037 | .942 | .30 | 4.625 | 5½ | 1″ | ¾ | 216.9 | 59.71 | 2 89 | 182.0 | 35.0 | 2.65 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 8" ROLLED COLUMNS

BETHLEHEM SECTIONS

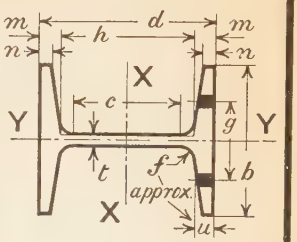
| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 |
| **8" BETHLEHEM BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 17.5 | 5.20 | 1.11 | 78 | 76 | 66 | 61 | 57 | 52 | 48 | 45 | 41 | 38 | 35 | 33 | 30 | | | | | | | |
| 19.0 | 5.68 | 1.13 | 85 | 83 | 73 | 68 | 63 | 58 | 54 | 50 | 46 | 42 | 39 | 36 | 34 | | | | | | | |
| **8" BETHLEHEM GIRDER BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 29.5 | 8.69 | 1.81 | 130 | 130 | 130 | 130 | 126 | 121 | 116 | 111 | 106 | 101 | 96 | 92 | 87 | 83 | 79 | 71 | 65 | 59 | 53 | |
| 33.0 | 9.69 | 1.86 | 145 | 145 | 145 | 145 | 141 | 136 | 131 | 125 | 120 | 115 | 110 | 105 | 100 | 95 | 91 | 82 | 75 | 68 | 62 | |
| 36.5 | 10.81 | 1.90 | 162 | 162 | 162 | 162 | 159 | 154 | 148 | 142 | 136 | 130 | 124 | 119 | 113 | 108 | 103 | 94 | 86 | 78 | 71 | |
| **8" BETHLEHEM H COLUMNS.** | | | | | | | | | | | | | | | | | | | | | | |
| 23.5 | 6.85 | 1.57 | 103 | 103 | 102 | 98 | 93 | 89 | 84 | 80 | 75 | 71 | 67 | 64 | 60 | 57 | 54 | 48 | 43 | | | |
| 27.0 | 7.89 | 1.59 | 118 | 118 | 118 | 113 | 108 | 103 | 98 | 93 | 88 | 83 | 78 | 74 | 70 | 66 | 63 | 56 | 50 | | | |
| 30.5 | 8.95 | 1.61 | 134 | 134 | 134 | 129 | 123 | 117 | 112 | 106 | 100 | 95 | 90 | 85 | 81 | 76 | 72 | 65 | 58 | | | |
| 34.5 | 10.10 | 1.62 | 152 | 152 | 152 | 146 | 139 | 133 | 126 | 120 | 114 | 108 | 102 | 97 | 91 | 87 | 82 | 74 | 66 | 59 | | |
| 32.0 | 9.30 | 1.96 | 140 | 140 | 140 | 140 | 139 | 134 | 129 | 124 | 119 | 114 | 109 | 105 | 100 | 96 | 91 | 83 | 76 | 70 | 64 | 58 |
| 35.0 | 10.30 | 2.00 | 155 | 155 | 155 | 155 | 155 | 149 | 144 | 139 | 133 | 128 | 123 | 117 | 113 | 108 | 103 | 94 | 86 | 79 | 72 | 66 |
| 39.5 | 11.63 | 2.01 | 174 | 174 | 174 | 174 | 174 | 169 | 163 | 157 | 151 | 145 | 139 | 133 | 128 | 122 | 117 | 107 | 98 | 89 | 82 | 75 |
| 44.0 | 12.96 | 2.03 | 194 | 194 | 194 | 194 | 194 | 189 | 182 | 176 | 169 | 162 | 156 | 149 | 143 | 137 | 131 | 120 | 110 | 101 | 93 | 85 |
| 48.5 | 14.31 | 2.04 | 215 | 215 | 215 | 215 | 215 | 209 | 202 | 194 | 187 | 180 | 173 | 166 | 159 | 152 | 146 | 133 | 122 | 112 | 103 | 94 |
| 53.0 | 15.66 | 2.06 | 235 | 235 | 235 | 235 | 235 | 230 | 222 | 214 | 206 | 198 | 190 | 182 | 175 | 168 | 161 | 147 | 135 | 124 | 114 | 105 |
| 58.0 | 17.03 | 2.07 | 255 | 255 | 255 | 255 | 255 | 250 | 242 | 233 | 224 | 216 | 207 | 199 | 191 | 183 | 175 | 161 | 148 | 134 | 124 | 114 |
| 62.5 | 18.40 | 2.09 | 276 | 276 | 276 | 276 | 276 | 271 | 262 | 253 | 244 | 235 | 225 | 217 | 208 | 199 | 191 | 176 | 161 | 148 | 136 | 125 |
| 67.5 | 19.79 | 2.10 | 297 | 297 | 297 | 297 | 297 | 292 | 282 | 273 | 263 | 253 | 243 | 234 | 224 | 215 | 206 | 190 | 174 | 160 | 147 | 135 |
| 72.0 | 21.18 | 2.11 | 318 | 318 | 318 | 318 | 318 | 313 | 303 | 292 | 282 | 271 | 261 | 251 | 241 | 231 | 222 | 204 | 187 | 172 | 158 | 146 |
| 77.0 | 22.59 | 2.12 | 339 | 339 | 339 | 339 | 339 | 335 | 324 | 313 | 301 | 290 | 279 | 269 | 258 | 248 | 238 | 218 | 201 | 185 | 170 | 156 |
| 81.5 | 23.91 | 2.14 | 359 | 359 | 359 | 359 | 359 | 355 | 344 | 332 | 321 | 309 | 297 | 286 | 275 | 264 | 253 | 233 | 215 | 197 | 181 | 167 |
| 86.0 | 25.33 | 2.15 | 380 | 380 | 380 | 380 | 380 | 377 | 365 | 353 | 340 | 328 | 316 | 304 | 292 | 281 | 269 | 248 | 228 | 210 | 194 | 178 |
| 91.0 | 26.77 | 2.16 | 402 | 402 | 402 | 402 | 402 | 399 | 386 | 374 | 361 | 348 | 335 | 322 | 310 | 298 | 286 | 263 | 242 | 223 | 206 | 190 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 8″ ROLLED COLUMNS

BETHLEHEM SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **8″ BETHLEHEM BEAMS** | | | | | | | | | | | | | | | | | |
| 17.5 | 8 000 | 5 250 | .250 | 7.164 | .418 | .210 | .30 | 6.625 | 2¼ | 11/32 | ¾ | 57 7 | 14.43 | 3.33 | 6 39 | 2.44 | 1.11 |
| 19 0 | 8 060 | 5 270 | .270 | 7 164 | .448 | .240 | .30 | 6.625 | 2¼ | ⅜ | ¾ | 62 9 | 15.60 | 3 35 | 7 20 | 2.73 | 1 13 |
| **8″ BETHLEHEM GIRDER BEAMS** | | | | | | | | | | | | | | | | | |
| 29.5 | 7.880 | 7.995 | .285 | 6.738 | .571 | .250 | .40 | 6.000 | 5½ | 11/32 | ⅞ | 100 7 | 25.56 | 3.41 | 28.4 | 7.10 | 1.81 |
| 33.0 | 8.000 | 8.000 | .290 | 6.738 | .631 | .310 | .40 | 6.000 | 5½ | 13/32 | ⅞ | 116.1 | 29.03 | 3.46 | 33.6 | 8.39 | 1.86 |
| 36.5 | 8 120 | 8.020 | .310 | 6.738 | .691 | .370 | .40 | 6.000 | 5½ | 15/32 | ⅞ | 132.6 | 32 66 | 3.50 | 39.0 | 9 72 | 1 90 |
| **8″ BETHLEHEM H COLUMNS** | | | | | | | | | | | | | | | | | |
| 23 5 | 7.750 | 6.500 | .250 | 6 923 | .413 | .351 | .40 | 6 125 | 3½ | ⅜ | ⅞ | 76.1 | 19 6 | 3 33 | 16 8 | 5 18 | 1.57 |
| 27 0 | 7 875 | 6 530 | .280 | 6.923 | .476 | .413 | .40 | 6 125 | 3½ | 7/16 | ⅞ | 89 7 | 22 8 | 3.37 | 20.0 | 6.11 | 1.59 |
| 30 5 | 8.000 | 6 560 | .310 | 6 923 | .538 | .476 | .40 | 6 125 | 3½ | ½ | ⅞ | 103 8 | 26 0 | 3.41 | 23.2 | 7.07 | 1.61 |
| 34.5 | 8 125 | 6 600 | .350 | 6 923 | .601 | .538 | .40 | 6.125 | 3½ | 9/16 | ⅞ | 118 9 | 29 3 | 3.43 | 26.6 | 8.07 | 1.62 |
| 32 0 | 7 875 | 8.000 | .310 | 6 923 | .476 | .399 | .40 | 6 125 | 5½ | 7/16 | ⅞ | 107.2 | 27.2 | 3.40 | 35.8 | 8.95 | 1.96 |
| 35 0 | 8 000 | 8 000 | .310 | 6 923 | .538 | .462 | .40 | 6.125 | 5½ | ½ | ⅞ | 123.0 | 30.7 | 3.46 | 41.1 | 10.28 | 2.00 |
| 39.5 | 8.125 | 8 040 | .350 | 6 923 | .601 | .524 | .40 | 6.125 | 5½ | 9/16 | ⅞ | 141 0 | 34.7 | 3.48 | 47.2 | 11.74 | 2.01 |
| 44.0 | 8 250 | 8 080 | .390 | 6 923 | .663 | .587 | .40 | 6 125 | 5½ | ⅝ | ⅞ | 159 7 | 38 7 | 3.51 | 53.4 | 13.22 | 2.03 |
| 48.5 | 8 375 | 8 120 | .430 | 6 923 | .726 | .649 | .40 | 6.125 | 5½ | 11/16 | ⅞ | 179.2 | 42 8 | 3.54 | 59 8 | 14.73 | 2.04 |
| 53 0 | 8.500 | 8.160 | .470 | 6 923 | .788 | .712 | .40 | 6 125 | 5½ | ¾ | ⅞ | 199 3 | 46 9 | 3 57 | 66.4 | 16.27 | 2.06 |
| 58 0 | 8 625 | 8.200 | .510 | 6.923 | .851 | .774 | .40 | 6.125 | 5½ | 13/16 | ⅞ | 220 1 | 51.0 | 3.60 | 73.1 | 17.83 | 2 07 |
| 62.5 | 8 750 | 8.240 | .550 | 6.923 | .913 | .837 | .40 | 6 125 | 5½ | ⅞ | ⅞ | 241 7 | 55.2 | 3.62 | 80 0 | 19.42 | 2 09 |
| 67.5 | 8 875 | 8.280 | .590 | 6.923 | .976 | .899 | .40 | 6.125 | 5½ | 15/16 | ⅞ | 264 0 | 59 5 | 3 65 | 87 2 | 21.06 | 2.10 |
| 72.0 | 9 000 | 8 320 | .630 | 6.923 | 1.038 | .962 | .40 | 6.125 | 5½ | 1 | ⅞ | 287.1 | 63.8 | 3.68 | 94 5 | 22 72 | 2.11 |
| 77 0 | 9.125 | 8 360 | .670 | 6 923 | 1 101 | 1.024 | .40 | 6.125 | 5½ | 1 1/16 | ⅞ | 311.0 | 68.2 | 3.71 | 102 0 | 24 40 | 2.12 |
| 81 5 | 9.250 | 8.390 | .700 | 6.923 | 1 163 | 1 087 | .40 | 6.125 | 5½ | 1 1/8 | ⅞ | 335.0 | 72.4 | 3.74 | 109 2 | 26.03 | 2.14 |
| 86.0 | 9.375 | 8.430 | .740 | 6.923 | 1.226 | 1.149 | .40 | 6.125 | 5½ | 1 3/16 | ⅞ | 360.5 | 76.9 | 3.77 | 117.1 | 27.78 | 2.15 |
| 91.0 | 9.500 | 8.470 | .780 | 6.923 | 1.288 | 1.212 | .40 | 6.125 | 5½ | 1 ¼ | ⅞ | 386.8 | 81.4 | 3.80 | 125.1 | 29.54 | 2.16 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

8″

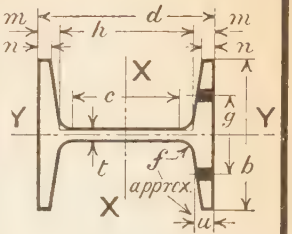
# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 10″ ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per Foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| 10″ BETHLEHEM Bs. | | | | | | | | | | | | | | | | | |
| 21.0 | 6.28 | 1.22 | 94 | 89 | 84 | 79 | 73 | 64 | 55 | 48 | 41 | 36 | | | | | |
| 23.5 | 6.96 | 1.25 | 104 | 100 | 94 | 89 | 83 | 72 | 63 | 54 | 47 | 41 | | | | | |
| 26.0 | 7.68 | 1.28 | 115 | 112 | 105 | 99 | 93 | 81 | 71 | 61 | 54 | 47 | | | | | |
| 28.5 | 8.41 | 1.30 | 126 | 123 | 116 | 109 | 103 | 90 | 78 | 68 | 60 | 52 | | | | | |
| 10″ BETHLEHEM Gs. | | | | | | | | | | | | | | | | | |
| 41.5 | 12.23 | 2 07 | 183 | 183 | 183 | 183 | 183 | 174 | 161 | 149 | 137 | 126 | 116 | 106 | 97 | 89 | 82 |
| 44.5 | 13.14 | 2 10 | 197 | 197 | 197 | 197 | 197 | 188 | 174 | 161 | 149 | 137 | 126 | 116 | 106 | 98 | 90 |
| 50.0 | 14.62 | 2 13 | 219 | 219 | 219 | 219 | 219 | 210 | 196 | 181 | 168 | 154 | 142 | 131 | 120 | 110 | 102 |
| 10″ BETHLEHEM H COLUMNS. | | | | | | | | | | | | | | | | | |
| 33.5 | 9.80 | 1.93 | 147 | 147 | 147 | 147 | 145 | 135 | 124 | 114 | 104 | 95 | 86 | 79 | 71 | 66 | |
| 38.0 | 11 09 | 1.96 | 166 | 166 | 166 | 166 | 165 | 154 | 142 | 130 | 119 | 109 | 99 | 91 | 83 | 76 | |
| 42.5 | 12.49 | 1.97 | 187 | 187 | 187 | 187 | 186 | 173 | 160 | 147 | 135 | 123 | 113 | 103 | 94 | 86 | 79 |
| 47.5 | 13.90 | 1.99 | 209 | 209 | 209 | 209 | 208 | 194 | 179 | 165 | 151 | 138 | 126 | 116 | 106 | 97 | 89 |
| 49.5 | 14.57 | 2.47 | 219 | 219 | 219 | 219 | 219 | 219 | 209 | 196 | 184 | 172 | 160 | 149 | 139 | 129 | 120 |
| 55.0 | 16.12 | 2.50 | 242 | 242 | 242 | 242 | 242 | 242 | 232 | 219 | 205 | 192 | 179 | 167 | 156 | 145 | 135 |
| 60.5 | 17.77 | 2.51 | 267 | 267 | 267 | 267 | 267 | 267 | 256 | 241 | 227 | 212 | 198 | 185 | 172 | 160 | 149 |
| 66.0 | 19.44 | 2.53 | 292 | 292 | 292 | 292 | 292 | 292 | 281 | 265 | 249 | 233 | 218 | 203 | 190 | 177 | 165 |
| 72.0 | 21.11 | 2.54 | 317 | 317 | 317 | 317 | 317 | 317 | 306 | 288 | 271 | 254 | 237 | 222 | 207 | 193 | 180 |
| 77.5 | 22.80 | 2.56 | 342 | 342 | 342 | 342 | 342 | 342 | 331 | 313 | 294 | 276 | 258 | 241 | 225 | 210 | 196 |
| 83.5 | 24.49 | 2.57 | 367 | 367 | 367 | 367 | 367 | 367 | 356 | 336 | 317 | 297 | 278 | 260 | 242 | 226 | 211 |
| 89.0 | 26.20 | 2.59 | 393 | 393 | 393 | 393 | 393 | 393 | 382 | 361 | 340 | 319 | 299 | 280 | 261 | 244 | 225 |
| 95.0 | 27.91 | 2.60 | 419 | 419 | 419 | 419 | 419 | 419 | 408 | 386 | 363 | 341 | 319 | 299 | 279 | 261 | 243 |
| 100.5 | 29.53 | 2.61 | 443 | 443 | 443 | 443 | 443 | 443 | 432 | 409 | 385 | 362 | 339 | 317 | 296 | 277 | 258 |
| 106.5 | 31.26 | 2.63 | 469 | 469 | 469 | 469 | 469 | 469 | 459 | 434 | 409 | 385 | 361 | 338 | 316 | 295 | 276 |
| 112.0 | 33.00 | 2.64 | 495 | 495 | 495 | 495 | 495 | 495 | 485 | 459 | 427 | 407 | 382 | 358 | 335 | 313 | 292 |
| 118.0 | 34.76 | 2.65 | 521 | 521 | 521 | 521 | 521 | 521 | 511 | 484 | 457 | 430 | 403 | 378 | 354 | 331 | 309 |
| 124.0 | 36.52 | 2.66 | 548 | 548 | 548 | 548 | 548 | 548 | 538 | 510 | 481 | 453 | 425 | 398 | 373 | 348 | 326 |
| 130.0 | 38.30 | 2.68 | 575 | 575 | 575 | 575 | 575 | 575 | 566 | 536 | 507 | 477 | 448 | 420 | 393 | 368 | 344 |
| 136.5 | 40.08 | 2.69 | 601 | 601 | 601 | 601 | 601 | 601 | 593 | 562 | 531 | 500 | 470 | 441 | 413 | 386 | 362 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 10″ ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per Foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Rivet | I | S | r | I | S | r |
| **10″ BETHLEHEM B⁵.** | | | | | | | | | | | | | | | | | |
| 21.0 | 9 90 | 5.740 | .240 | 8.972 | .464 | .235 | 30 | 8.375 | 2¾ | 11/32 | ⅞ | 108 1 | 21 84 | 4.15 | 9.3 | 3.24 | 1 22 |
| 23.5 | 10.00 | 5.750 | .250 | 8 972 | .514 | .285 | .30 | 8.375 | 2¾ | 13 32 | ⅞ | 123 2 | 24 64 | 4.21 | 10 9 | 3.80 | 1.25 |
| 26.0 | 10 09 | 5.770 | .270 | 8.972 | .559 | .330 | .30 | 8.375 | 2¾ | 15/32 | ⅞ | 137.9 | 27.33 | 4.24 | 12 5 | 4.33 | 1.28 |
| 28 5 | 10.19 | 5.785 | .285 | 8 972 | .609 | .380 | .30 | 8 375 | 2¾ | ½ | ⅞ | 154.1 | 30 25 | 4.28 | 14 2 | 4 92 | 1.30 |
| **10″ BETHLEHEM G⁵.** | | | | | | | | | | | | | | | | | |
| 41.5 | 9.91 | 8 990 | .310 | 8 506 | .702 | .340 | .40 | 7.750 | 5½ | ½ | ⅞ | 225 8 | 45 57 | 4 30 | 52.6 | 11.7 | 2.07 |
| 44.5 | 10 00 | 9.000 | .320 | 8 506 | .747 | .385 | .40 | 7.750 | 5½ | 9/16 | ⅞ | 246 7 | 49 34 | 4 33 | 58.2 | 12 9 | 2 10 |
| 50 0 | 10.12 | 9 040 | .360 | 8 506 | .807 | .445 | .40 | 7.750 | 5½ | ⅝ | ⅞ | 277 5 | 54 84 | 4 36 | 66 4 | 14.7 | 2.13 |
| **10″ BETHLEHEM H COLUMNS** | | | | | | | | | | | | | | | | | |
| 33 5 | 9 625 | 8 00 | .28 | 8 653 | .486 | 408 | | 7.688 | 5½ | 7/16 | ⅞ | 169 9 | 35 30 | 4.16 | 36 6 | 9.15 | 1.93 |
| 38 0 | 9 750 | 8 03 | .31 | 8 653 | .548 | .471 | | 7 688 | 5½ | ½ | ⅞ | 195 6 | 40.12 | 4.20 | 42.4 | 10.56 | 1.96 |
| 42.5 | 9 875 | 8 07 | .35 | 8 653 | .611 | .533 | | 7.688 | 5½ | 9/16 | ⅞ | 223 0 | 45.16 | 4.23 | 48 5 | 12 02 | 1.97 |
| 47.5 | 10.000 | 8 11 | .39 | 8 653 | .673 | .596 | | 7 688 | 5½ | ⅝ | ⅞ | 251.3 | 50.26 | 4.25 | 54.8 | 13.51 | 1.99 |
| 49 5 | 9 875 | 9 97 | .36 | 8 653 | .611 | .514 | | 7.688 | 5½ | 9/16 | ⅞ | 267.2 | 54 1 | 4.28 | 89.1 | 17.9 | 2.47 |
| 55 0 | 10 000 | 10 00 | .39 | 8 653 | .673 | .577 | | 7 688 | 5½ | ⅝ | ⅞ | 300.4 | 60 1 | 4 32 | 100.4 | 20.1 | 2.50 |
| 60 5 | 10 125 | 10 04 | .43 | 8 653 | .736 | .639 | | 7 688 | 5½ | 11/16 | ⅞ | 335.5 | 66.3 | 4.34 | 112.2 | 22.3 | 2.51 |
| 66 0 | 10 250 | 10.08 | .47 | 8 653 | .798 | .702 | | 7 688 | 5½ | ¾ | ⅞ | 371.7 | 72 5 | 4.37 | 124 2 | 24 6 | 2.53 |
| 72 0 | 10 375 | 10.12 | .51 | 8 653 | .861 | .764 | | 7 688 | | 13/16 | ⅞ | 408.9 | 78 8 | 4.40 | 136.5 | 27.0 | 2.54 |
| 77.5 | 10 500 | 10 16 | .55 | 8 653 | .923 | .827 | | 7 688 | 5½ | ⅞ | ⅞ | 447 2 | 85.2 | 4.43 | 149.1 | 29.4 | 2.56 |
| 83 5 | 10.625 | 10 20 | .59 | 8 653 | .986 | .889 | | 7 688 | 5½ | 15/16 | ⅞ | 486 6 | 91.6 | 4.46 | 162 0 | 31.8 | 2.57 |
| 89 0 | 10.750 | 10 24 | .63 | 8 653 | 1 048 | .952 | | 7 688 | 5½ | 1″ | ⅞ | 527.2 | 98.1 | 4.49 | 175.2 | 34.2 | 2.59 |
| 95 0 | 10 875 | 10.28 | .67 | 8.653 | 1 111 | 1 014 | | 7.688 | 5½ | 1 1/16 | ⅞ | 568.9 | 104.6 | 4.51 | 188 6 | 36.7 | 2.60 |
| 100.5 | 11.000 | 10 31 | .70 | 8.653 | 1.173 | 1.077 | | 7.688 | 5½ | 1 ⅛ | ⅞ | 610.6 | 111.0 | 4.55 | 201.7 | 39.1 | 2.61 |
| 106 5 | 11 125 | 10 35 | .74 | 8.653 | 1 236 | 1.139 | | 7 688 | 5½ | 1 3/16 | ⅞ | 654 7 | 117.7 | 4 58 | 215.7 | 41 7 | 2.63 |
| 112 0 | 11.250 | 10 39 | .78 | 8.653 | 1 298 | 1 202 | | 7.688 | 5½ | 1 ¼ | ⅞ | 699.9 | 124 4 | 4.60 | 229 9 | 44.3 | 2.64 |
| 118 0 | 11 375 | 10.43 | .82 | 8.653 | 1 361 | 1.264 | | 7 688 | 5½ | 1 5/16 | ⅞ | 746 3 | 131.2 | 4.63 | 244 5 | 46 9 | 2.65 |
| 124 0 | 11.500 | 10 47 | .86 | 8.653 | 1 423 | 1 327 | | 7 688 | 5½ | 1 3/8 | ⅞ | 794 0 | 138 1 | 4.66 | 259.4 | 49.5 | 2 66 |
| 130.0 | 11.625 | 10 51 | .90 | 8.653 | 1.486 | 1 389 | | 7.688 | 5½ | 1 7/16 | ⅞ | 843.0 | 145.0 | 4.69 | 274.5 | 52.2 | 2.68 |
| 136 5 | 11.750 | 10 55 | .94 | 8 653 | 1.548 | 1.452 | | 7.688 | 5½ | 1 ½ | ⅞ | 893.3 | 152.1 | 4.72 | 290.0 | 55.0 | 2.69 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

10″

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 10" ROLLED COLUMNS

BETHLEHEM SECTIONS

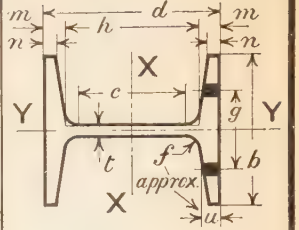
| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| 10" BETHLEHEM H COLUMNS | | | | | | | | | | | | | | | | | |
| 62.0 | 18.29 | 3.04 | 274 | 274 | 270 | 258 | 245 | 232 | 220 | 208 | 196 | 185 | 174 | 164 | 155 | 146 | 138 |
| 68.0 | 20.13 | 3.05 | 302 | 302 | 297 | 283 | 270 | 256 | 242 | 229 | 216 | 204 | 193 | 182 | 171 | 162 | 152 |
| 75.0 | 22.00 | 3.08 | 330 | 330 | 326 | 311 | 296 | 281 | 267 | 252 | 238 | 225 | 212 | 200 | 189 | 179 | 169 |
| 82.0 | 23.98 | 3.09 | 360 | 360 | 355 | 340 | 323 | 307 | 291 | 276 | 261 | 246 | 232 | 219 | 207 | 195 | 184 |
| 88.0 | 25.86 | 3.11 | 388 | 388 | 384 | 367 | 350 | 332 | 315 | 298 | 282 | 267 | 252 | 238 | 225 | 212 | 200 |
| 94.0 | 27.63 | 3.12 | 414 | 414 | 411 | 393 | 374 | 356 | 338 | 320 | 302 | 286 | 270 | 255 | 241 | 227 | 215 |
| 100.0 | 29.54 | 3.14 | 443 | 443 | 440 | 421 | 401 | 382 | 362 | 343 | 325 | 307 | 290 | 274 | 259 | 245 | 231 |
| 107.0 | 31.45 | 3.16 | 472 | 472 | 470 | 449 | 429 | 408 | 387 | 367 | 348 | 329 | 311 | 294 | 278 | 263 | 248 |
| 113.0 | 33.25 | 3.17 | 499 | 499 | 497 | 476 | 454 | 432 | 410 | 389 | 368 | 348 | 330 | 312 | 295 | 279 | 263 |
| 125.0 | 36.89 | 3.65 | 553 | 553 | 553 | 553 | 535 | 514 | 493 | 472 | 451 | 431 | 411 | 392 | 373 | 356 | 339 |
| 133.0 | 39.02 | 3.66 | 585 | 585 | 585 | 585 | 567 | 545 | 523 | 500 | 478 | 457 | 436 | 416 | 396 | 377 | 359 |
| 140.0 | 41.29 | 3.68 | 619 | 619 | 619 | 619 | 601 | 578 | 555 | 531 | 508 | 486 | 463 | 442 | 421 | 401 | 382 |
| 148.0 | 43.46 | 3.69 | 652 | 652 | 652 | 652 | 633 | 609 | 585 | 560 | 535 | 512 | 488 | 466 | 444 | 423 | 403 |
| 155.0 | 45.62 | 3.70 | 684 | 684 | 684 | 684 | 666 | 640 | 614 | 588 | 563 | 538 | 514 | 490 | 467 | 445 | 424 |
| 162.0 | 47.78 | 3.72 | 717 | 717 | 717 | 717 | 699 | 672 | 645 | 618 | 592 | 566 | 540 | 516 | 492 | 469 | 447 |
| 170.0 | 49.98 | 3.73 | 750 | 750 | 750 | 750 | 731 | 704 | 676 | 648 | 620 | 593 | 566 | 540 | 515 | 491 | 468 |
| 177.0 | 52.18 | 3.74 | 783 | 783 | 783 | 783 | 764 | 736 | 706 | 677 | 648 | 620 | 592 | 566 | 540 | 514 | 490 |
| 185.0 | 54.37 | 3.76 | 816 | 816 | 816 | 816 | 798 | 768 | 738 | 708 | 678 | 648 | 620 | 592 | 564 | 538 | 513 |
| 192.0 | 56.45 | 3.77 | 847 | 847 | 847 | 847 | 829 | 799 | 767 | 736 | 705 | 675 | 645 | 615 | 588 | 561 | 535 |
| 200.0 | 58.80 | 3.78 | 882 | 882 | 882 | 882 | 864 | 833 | 800 | 768 | 736 | 704 | 673 | 642 | 613 | 585 | 559 |
| 208.0 | 61.17 | 3.79 | 918 | 918 | 918 | 918 | 900 | 867 | 834 | 800 | 766 | 733 | 701 | 670 | 640 | 610 | 582 |
| 215.0 | 63.27 | 3.80 | 949 | 949 | 949 | 949 | 932 | 898 | 863 | 828 | 794 | 760 | 727 | 694 | 663 | 633 | 604 |
| 222.0 | 65.38 | 3.81 | 981 | 981 | 981 | 981 | 964 | 929 | 893 | 858 | 822 | 787 | 752 | 719 | 686 | 655 | 626 |
| 230.0 | 67.77 | 3.83 | 1017 | 1017 | 1017 | 1017 | 1002 | 965 | 928 | 891 | 855 | 818 | 783 | 748 | 714 | 682 | 651 |
| 238.0 | 70.04 | 3.84 | 1051 | 1051 | 1051 | 1051 | 1036 | 999 | 961 | 922 | 885 | 847 | 810 | 775 | 740 | 707 | 675 |
| 246.0 | 72.30 | 3.85 | 1085 | 1085 | 1085 | 1085 | 1070 | 1032 | 993 | 954 | 915 | 876 | 838 | 801 | 766 | 731 | 698 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 10″ ROLLED COLUMNS

BETHLEHEM SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **10″ BETHLEHEM H COLUMNS** | | | | | | | | | | | | | | | | | |
| 62.0 | 10.000 | 11.99 | .38 | 8.654 | .673 | .557 | .50 | 7.688 | 9″ | 9/16 | 1″ | 350.1 | 70.0 | 4.38 | 168.7 | 28.1 | 3.04 |
| 68.0 | 10.125 | 12.03 | .42 | 8.654 | .733 | .617 | .50 | 7.688 | 9″ | 5/8 | 1″ | 390.0 | 77.1 | 4.40 | 187.8 | 31.2 | 3.05 |
| 75.0 | 10.250 | 12.06 | .45 | 8.654 | .798 | .682 | .50 | 7.688 | 9″ | 11/16 | 1″ | 433.2 | 84.5 | 4.44 | 208.3 | 34.5 | 3.08 |
| 82.0 | 10.375 | 12.10 | .49 | 8.654 | .863 | .747 | .50 | 7.688 | 9″ | 3/4 | 1″ | 478.6 | 92.2 | 4.47 | 229.6 | 37.9 | 3.09 |
| 88.0 | 10.500 | 12.14 | .53 | 8.654 | .923 | .807 | .50 | 7.688 | 9″ | 13/16 | 1″ | 522.1 | 99.4 | 4.49 | 249.8 | 41.2 | 3.11 |
| 94.0 | 10.625 | 12.17 | .56 | 8.654 | .983 | .867 | .50 | 7.688 | 9″ | 7/8 | 1″ | 565.7 | 106.5 | 4.52 | 269.7 | 44.3 | 3.12 |
| 100.0 | 10.750 | 12.20 | .59 | 8.654 | 1.048 | .932 | .50 | 7.688 | 9″ | 15/16 | 1″ | 613.9 | 114.2 | 4.56 | 291.5 | 47.8 | 3.14 |
| 107.0 | 10.875 | 12.23 | .62 | 8.654 | 1.113 | .997 | .50 | 7.688 | 9″ | 1″ | 1″ | 663.5 | 122.0 | 4.59 | 313.5 | 51.3 | 3.16 |
| 113.0 | 11.000 | 12.26 | .65 | 8.654 | 1.173 | 1.057 | .50 | 7.688 | 9″ | 1 1/16 | 1″ | 710.8 | 129.2 | 4.62 | 334.3 | 54.5 | 3.17 |
| 125.0 | 11.000 | 14.00 | .65 | 8.654 | 1.173 | 1.040 | .50 | 7.688 | 10″ | 1 1/16 | 1″ | 801.4 | 145.7 | 4.66 | 491.7 | 70.2 | 3.65 |
| 133.0 | 11.125 | 14.04 | .69 | 8.654 | 1.233 | 1.100 | .50 | 7.688 | 10″ | 1 1/8 | 1″ | 857.4 | 154.2 | 4.69 | 523.7 | 74.6 | 3.66 |
| 140.0 | 11.250 | 14.08 | .73 | 8.654 | 1.298 | 1.165 | .50 | 7.688 | 10″ | 1 3/16 | 1″ | 919.2 | 163.4 | 4.72 | 558.5 | 79.3 | 3.68 |
| 148.0 | 11.375 | 14.11 | .76 | 8.654 | 1.363 | 1.230 | .50 | 7.688 | 10″ | 1 1/4 | 1″ | 981.5 | 172.5 | 4.75 | 592.6 | 84.0 | 3.69 |
| 155.0 | 11.500 | 14.15 | .80 | 8.654 | 1.423 | 1.290 | .50 | 7.688 | 10″ | 1 5/16 | 1″ | 1042.0 | 181.2 | 4.78 | 626.0 | 88.5 | 3.70 |
| 162.0 | 11.625 | 14.19 | .84 | 8.654 | 1.483 | 1.350 | .50 | 7.688 | 10″ | 1 3/8 | 1″ | 1103.9 | 190.0 | 4.81 | 660.0 | 93.0 | 3.72 |
| 170.0 | 11.750 | 14.22 | .87 | 8.654 | 1.548 | 1.415 | .50 | 7.688 | 10″ | 1 7/16 | 1″ | 1170.9 | 199.3 | 4.84 | 695.5 | 97.8 | 3.73 |
| 177.0 | 11.875 | 14.25 | .90 | 8.654 | 1.613 | 1.480 | .50 | 7.688 | 10″ | 1 1/2 | 1″ | 1239.6 | 208.7 | 4.87 | 731.3 | 102.6 | 3.74 |
| 185.0 | 12.000 | 14.29 | .94 | 8.654 | 1.673 | 1.540 | .50 | 7.688 | 10″ | 1 9/16 | 1″ | 1306.3 | 217.7 | 4.90 | 766.8 | 107.3 | 3.76 |
| 192.0 | 12.125 | 14.32 | .97 | 8.654 | 1.733 | 1.600 | .50 | 7.688 | 10″ | 1 5/8 | 1″ | 1373.2 | 226.6 | 4.93 | 801.1 | 111.9 | 3.77 |
| 200.0 | 12.250 | 14.36 | 1.01 | 8.654 | 1.798 | 1.665 | .50 | 7.688 | 10″ | 1 11/16 | 1″ | 1448.4 | 236.5 | 4.96 | 840.0 | 117.0 | 3.78 |
| 208.0 | 12.375 | 14.40 | 1.05 | 8.654 | 1.863 | 1.730 | .50 | 7.688 | 10″ | 1 3/4 | 1″ | 1525.5 | 246.4 | 4.99 | 879.6 | 122.2 | 3.79 |
| 215.0 | 12.500 | 14.43 | 1.08 | 8.654 | 1.923 | 1.790 | .50 | 7.688 | 10″ | 1 13/16 | 1″ | 1597.2 | 255.6 | 5.02 | 915.2 | 126.9 | 3.80 |
| 222.0 | 12.625 | 14.46 | 1.11 | 8.654 | 1.983 | 1.850 | .50 | 7.688 | 10″ | 1 7/8 | 1″ | 1670.5 | 264.7 | 5.05 | 951.3 | 131.6 | 3.81 |
| 230.0 | 12.750 | 14.50 | 1.15 | 8.654 | 2.048 | 1.915 | .50 | 7.688 | 10″ | 1 15/16 | 1″ | 1753.1 | 275.0 | 5.09 | 992.4 | 136.9 | 3.83 |
| 238.0 | 12.875 | 14.53 | 1.18 | 8.654 | 2.113 | 1.980 | .50 | 7.688 | 10″ | 2″ | 1″ | 1835.8 | 285.1 | 5.12 | 1031.9 | 142.0 | 3.84 |
| 246.0 | 13.000 | 14.57 | 1.22 | 8.654 | 2.173 | 2.040 | .50 | 7.688 | 10″ | 2 1/16 | 1″ | 1916.1 | 294.8 | 5.15 | 1071.6 | 147.1 | 3.85 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

10″

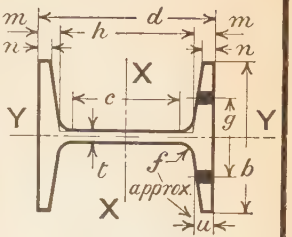
# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 12" ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per Foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 8 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 |
| **12" BETHLEHEM Bs.** | | | | | | | | | | | | | | | | | |
| 28.0 | 8.28 | 1.41 | 124 | 118 | 94 | 83 | 73 | 65 | 57 | 51 | | | | | | | |
| 36.0 | 10.58 | 1.46 | 159 | 154 | 124 | 110 | 97 | 86 | 76 | 68 | 60 | | | | | | |
| 40.0 | 11.80 | 1.53 | 177 | 174 | 142 | 127 | 113 | 101 | 90 | 80 | 72 | | | | | | |
| 48.5 | 14.28 | 1.57 | 214 | 213 | 175 | 157 | 140 | 125 | 112 | 100 | 90 | | | | | | |
| **12" BETHLEHEM Gs.** | | | | | | | | | | | | | | | | | |
| 55.5 | 16.35 | 2.28 | 245 | 245 | 241 | 226 | 211 | 196 | 182 | 169 | 156 | 144 | 134 | 123 | | | |
| 61.0 | 17.92 | 2.31 | 269 | 269 | 265 | 249 | 233 | 217 | 202 | 187 | 173 | 160 | 148 | 137 | 127 | | |
| 70.5 | 20.79 | 2.40 | 312 | 312 | 312 | 294 | 276 | 258 | 241 | 224 | 208 | 193 | 179 | 166 | 154 | | |
| 76.5 | 22.50 | 2.42 | 338 | 338 | 338 | 319 | 300 | 281 | 262 | 244 | 227 | 210 | 196 | 182 | 169 | | |
| **12" BETHLEHEM H COLUMNS.** | | | | | | | | | | | | | | | | | |
| 40.5 | 11.85 | 1.90 | 178 | 178 | 162 | 149 | 136 | 124 | 113 | 103 | 94 | 85 | 78 | | | | |
| 45.5 | 13.31 | 1.92 | 200 | 200 | 183 | 168 | 154 | 141 | 128 | 117 | 106 | 97 | 89 | | | | |
| 50.5 | 14.79 | 1.93 | 222 | 222 | 203 | 187 | 172 | 157 | 143 | 131 | 119 | 109 | 99 | | | | |
| 55.0 | 16.27 | 1.94 | 244 | 244 | 224 | 207 | 190 | 173 | 158 | 144 | 132 | 120 | 110 | | | | |
| 52.5 | 15.40 | 2.44 | 231 | 231 | 231 | 219 | 206 | 193 | 180 | 168 | 156 | 145 | 135 | 126 | 117 | 109 | |
| 58.0 | 17.12 | 2.45 | 257 | 257 | 257 | 244 | 230 | 215 | 201 | 187 | 174 | 162 | 151 | 140 | 130 | 121 | |
| 64.0 | 18.85 | 2.47 | 283 | 283 | 283 | 270 | 254 | 238 | 223 | 208 | 193 | 180 | 167 | 156 | 145 | 135 | |
| 70.0 | 20.59 | 2.49 | 309 | 309 | 309 | 296 | 279 | 261 | 244 | 228 | 213 | 198 | 184 | 172 | 160 | 149 | |
| 65.5 | 19.29 | 2.96 | 289 | 289 | 289 | 289 | 281 | 268 | 254 | 241 | 228 | 215 | 202 | 191 | 179 | 169 | 159 |
| 72.5 | 21.25 | 2.98 | 319 | 319 | 319 | 319 | 311 | 296 | 281 | 266 | 252 | 238 | 224 | 211 | 199 | 187 | 176 |
| 79.0 | 23.23 | 2.99 | 348 | 348 | 348 | 348 | 340 | 324 | 308 | 292 | 276 | 261 | 246 | 232 | 218 | 206 | 194 |
| 85.5 | 25.21 | 3.01 | 378 | 378 | 378 | 378 | 370 | 353 | 335 | 318 | 301 | 284 | 268 | 253 | 238 | 225 | 212 |
| 92.5 | 27.21 | 3.03 | 408 | 408 | 408 | 408 | 400 | 382 | 363 | 345 | 326 | 308 | 291 | 275 | 259 | 244 | 230 |
| 99.5 | 29.21 | 3.04 | 438 | 438 | 438 | 438 | 430 | 411 | 391 | 371 | 351 | 332 | 313 | 296 | 279 | 263 | 248 |
| 106.0 | 31.23 | 3.06 | 468 | 468 | 468 | 468 | 461 | 440 | 419 | 398 | 377 | 356 | 337 | 318 | 300 | 283 | 267 |
| 113.0 | 33.25 | 3.07 | 499 | 499 | 499 | 499 | 492 | 469 | 447 | 424 | 402 | 380 | 359 | 339 | 320 | 302 | 285 |
| 119.5 | 35.16 | 3.09 | 527 | 527 | 527 | 527 | 521 | 498 | 474 | 450 | 427 | 404 | 382 | 361 | 341 | 321 | 303 |
| 126.5 | 37.21 | 3.10 | 558 | 558 | 558 | 558 | 552 | 528 | 502 | 477 | 453 | 429 | 405 | 383 | 362 | 341 | 322 |
| 133.5 | 39.26 | 3.11 | 589 | 589 | 589 | 589 | 583 | 557 | 531 | 505 | 479 | 453 | 429 | 405 | 383 | 361 | 341 |
| 140.5 | 41.32 | 3.13 | 620 | 620 | 620 | 620 | 615 | 588 | 561 | 533 | 506 | 479 | 453 | 428 | 405 | 382 | 361 |
| 147.5 | 43.40 | 3.14 | 651 | 651 | 651 | 651 | 647 | 619 | 590 | 561 | 532 | 504 | 477 | 451 | 427 | 403 | 381 |
| 154.5 | 45.48 | 3.15 | 682 | 682 | 682 | 682 | 679 | 649 | 619 | 589 | 559 | 530 | 502 | 474 | 448 | 423 | 400 |
| 162.0 | 47.57 | 3.17 | 714 | 714 | 714 | 714 | 711 | 681 | 649 | 618 | 587 | 557 | 527 | 499 | 472 | 446 | 421 |
| 169.0 | 49.68 | 3.18 | 745 | 745 | 745 | 745 | 744 | 712 | 679 | 647 | 614 | 583 | 552 | 522 | 494 | 467 | 442 |
| 176.0 | 51.79 | 3.19 | 777 | 777 | 777 | 777 | 776 | 743 | 709 | 675 | 642 | 609 | 577 | 546 | 516 | 488 | 462 |
| 183.0 | 53.78 | 3.20 | 807 | 807 | 807 | 807 | 807 | 773 | 738 | 702 | 668 | 633 | 600 | 568 | 538 | 509 | 481 |
| 190.0 | 55.91 | 3.22 | 839 | 839 | 839 | 839 | 839 | 805 | 769 | 733 | 697 | 661 | 627 | 594 | 562 | 532 | 503 |

Loads to right of heavy vertical lines for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 12″ ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per Foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Rivet | I | S | r | I | S | r |
| **12″ BETHLEHEM Bs** | | | | | | | | | | | | | | | | | |
| 28 0 | 12.00 | 6.500 | .245 | 10 900 | .550 | .290 | .35 | 10.250 | 3 | 7/16 | 3/4 | 213.6 | 35.60 | 5.08 | 16 4 | 5.04 | 1.41 |
| 36 0 | 12 25 | 6.555 | .300 | 10.900 | .675 | .415 | .35 | 10.250 | 3 | 9/16 | 3/4 | 281 8 | 46.01 | 5.16 | 22.7 | 6.93 | 1.46 |
| 40.0 | 12.00 | 6 750 | .330 | 10.530 | .735 | .468 | .40 | 9.750 | 3 | 23/32 | 3/4 | 301.2 | 50 20 | 5.05 | 27.6 | 8.18 | 1.53 |
| 48 5 | 12 25 | 6 815 | .395 | 10.530 | .860 | .593 | .40 | 9.750 | 3 | 27/32 | 3/4 | 373.2 | 60 93 | 5.11 | 35 1 | 10 29 | 1.57 |
| **12″ BETHLEHEM Gs** | | | | | | | | | | | | | | | | | |
| 55.5 | 12 00 | 10.000 | .380 | 10 388 | .806 | .405 | .45 | 9.500 | 5½ | 5/8 | 1″ | 435.6 | 72.60 | 5.16 | 84.9 | 17.0 | 2.28 |
| 61.0 | 12.12 | 10 030 | .410 | 10.388 | .866 | .465 | .45 | 9.500 | 5½ | 11/16 | 1″ | 483.6 | 79.80 | 5.20 | 95.9 | 19.1 | 2.31 |
| 70 5 | 12 00 | 10.250 | .470 | 10.066 | .967 | .560 | .55 | 9.000 | 5½ | 25/32 | 1″ | 543.6 | 90.60 | 5.11 | 119.7 | 23 4 | 2.40 |
| 76 5 | 12 12 | 10 290 | .510 | 10.066 | 1 027 | .620 | .55 | 9 000 | 5½ | 13/16 | 1″ | 594.2 | 98.05 | 5.14 | 132 1 | 25 7 | 2.42 |
| **12″ BETHLEHEM H COLUMNS** | | | | | | | | | | | | | | | | | |
| 40.5 | 11.500 | 8.00 | .31 | 10.384 | .558 | .481 | | 9.188 | 5½ | 1/2 | 1″ | 287.7 | 50.0 | 4.93 | 42.8 | 10.7 | 1.90 |
| 45.5 | 11.625 | 8.04 | .35 | 10.384 | .620 | .543 | | 9.188 | 5½ | 9/16 | 1″ | 326.4 | 56.1 | 4.95 | 48.9 | 12.2 | 1.92 |
| 50.5 | 11 750 | 8.08 | .39 | 10.384 | .683 | .606 | | 9.188 | 5½ | 5/8 | 1″ | 366.1 | 62.3 | 4.98 | 55 1 | 13.6 | 1.93 |
| 55.0 | 11.875 | 8.12 | .43 | 10.384 | .745 | .668 | | 9.188 | 5½ | 11/16 | 1″ | 406.9 | 68.5 | 5.00 | 61.5 | 15.2 | 1.94 |
| 52.5 | 11.625 | 10.00 | .35 | 10.384 | .620 | .524 | | 9.188 | 5½ | 9/16 | 1″ | 390.7 | 67.2 | 5.04 | 91.5 | 18.3 | 2.44 |
| 58.0 | 11.750 | 10 04 | .39 | 10.384 | .683 | .586 | | 9.188 | 5½ | 5/8 | 1″ | 438.8 | 74.7 | 5.06 | 103.2 | 20.6 | 2.45 |
| 64.0 | 11.875 | 10.08 | .43 | 10.384 | .745 | .649 | | 9.188 | 5½ | 11/16 | 1″ | 488.2 | 82.2 | 5.09 | 115.1 | 22.8 | 2.47 |
| 70.0 | 12.000 | 10.12 | .47 | 10.384 | .808 | .711 | | 9.188 | 5½ | 3/4 | 1″ | 538.8 | 89.8 | 5.12 | 127.3 | 25.2 | 2.49 |
| 65.5 | 11.750 | 11 92 | .39 | 10.384 | .683 | .567 | | 9.188 | 9″ | 5/8 | 1″ | 506 6 | 86.2 | 5.12 | 168.6 | 28.3 | 2.96 |
| 72.5 | 11.875 | 11.96 | .43 | 10.384 | .745 | .630 | | 9.188 | 9″ | 11/16 | 1″ | 564.1 | 95.0 | 5.15 | 188.2 | 31.5 | 2.98 |
| 79.0 | 12.000 | 12.00 | .47 | 10.384 | .808 | .692 | | 9.188 | 9″ | 3/4 | 1″ | 623.1 | 103.9 | 5.18 | 208.2 | 34.7 | 2.99 |
| 85.5 | 12.125 | 12 04 | .51 | 10 384 | .870 | .755 | | 9 188 | 9″ | 13/16 | 1″ | 683 6 | 112.8 | 5.21 | 228 5 | 38.0 | 3.01 |
| 92.5 | 12.250 | 12.08 | .55 | 10.384 | .933 | .817 | | 9.188 | 9″ | 7/8 | 1″ | 745.7 | 121.7 | 5.23 | 249.2 | 41.3 | 3.03 |
| 99.5 | 12 375 | 12.12 | .59 | 10.384 | .995 | .880 | | 9.188 | 9″ | 15/16 | 1″ | 809 2 | 130.8 | 5.26 | 270.3 | 44 6 | 3.04 |
| 106 0 | 12.500 | 12 16 | .63 | 10.384 | 1.058 | .942 | | 9.188 | 9″ | 1″ | 1″ | 874.3 | 139.9 | 5.29 | 291.8 | 48.0 | 3.06 |
| 113.0 | 12.625 | 12.20 | .67 | 10.384 | 1.120 | 1.005 | | 9.188 | 9″ | 1 1/16 | 1″ | 941.0 | 149.1 | 5.32 | 313.7 | 51.4 | 3.07 |
| 119.5 | 12.750 | 12.23 | .70 | 10 384 | 1.183 | 1 067 | | 9 188 | 9″ | 1 1/8 | 1″ | 1007.5 | 158.0 | 5.35 | 335.1 | 54.8 | 3.09 |
| 126 5 | 12.875 | 12.27 | .74 | 10.384 | 1.245 | 1.130 | | 9.188 | 9″ | 1 3/16 | 1″ | 1077.4 | 167.4 | 5.38 | 357.7 | 58.3 | 3.10 |
| 133.5 | 13 000 | 12 31 | .78 | 10.384 | 1.308 | 1.192 | | 9.188 | 9″ | 1 1/4 | 1″ | 1148.9 | 176.8 | 5.41 | 380.8 | 61.9 | 3.11 |
| 140.5 | 13.125 | 12 35 | .82 | 10.384 | 1.370 | 1.255 | | 9.188 | 9″ | 1 5/16 | 1″ | 1222.1 | 186.2 | 5.44 | 404.2 | 65.5 | 3.13 |
| 147.5 | 13.250 | 12.39 | .86 | 10.384 | 1.433 | 1.317 | | 9.188 | 9″ | 1 3/8 | 1″ | 1296 9 | 195.8 | 5.47 | 428.1 | 69.1 | 3.14 |
| 154.5 | 13.375 | 12 43 | .90 | 10.384 | 1.495 | 1.380 | | 9.188 | 9″ | 1 7/16 | 1″ | 1373 5 | 205.4 | 5.50 | 452 3 | 72.8 | 3.15 |
| 162 0 | 13.500 | 12 47 | .94 | 10.384 | 1.558 | 1.442 | | 9.188 | 9″ | 1 1/2 | 1″ | 1451.9 | 215.1 | 5.52 | 477.0 | 76.5 | 3.17 |
| 169 0 | 13 625 | 12 51 | .98 | 10.384 | 1.620 | 1.505 | | 9.188 | 9″ | 1 9/16 | 1″ | 1532 0 | 224.9 | 5.55 | 502.2 | 80.3 | 3.18 |
| 176 0 | 13.750 | 12.55 | 1 02 | 10.384 | 1.683 | 1.567 | | 9.188 | 9″ | 1 5/8 | 1″ | 1613.9 | 234.7 | 5.58 | 527.7 | 84 1 | 3.19 |
| 183 0 | 13 875 | 12 58 | 1 05 | 10.384 | 1.745 | 1.630 | | 9.188 | 9″ | 1 11/16 | 1″ | 1695.4 | 244.4 | 5.61 | 552.4 | 87.8 | 3.20 |
| 190 0 | 14.000 | 12 62 | 1 09 | 10.384 | 1.808 | 1.692 | | 9.188 | 9″ | 1 3/4 | 1″ | 1780.9 | 254.4 | 5.64 | 578.7 | 91.7 | 3.22 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

12″

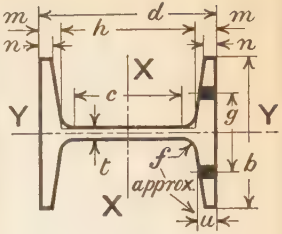
# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14″ ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight Per Foot | Area Square Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 36 | 40 | 44 | 48 |
| 14″ BETHLEHEM H COLUMNS 8—10 and 12″ Nominal Flange Widths | | | | | | | | | | | | | | | | | | | |
| 43.0 | 12.58 | 1.86 | 189 | 184 | 170 | 156 | 142 | 129 | 118 | 107 | 97 | 88 | 81 | | | | | | |
| 48.0 | 14.12 | 1.88 | 212 | 207 | 192 | 176 | 161 | 147 | 133 | 121 | 110 | 101 | 92 | | | | | | |
| 53.5 | 15 67 | 1.89 | 235 | 231 | 213 | 196 | 179 | 163 | 149 | 135 | 123 | 112 | 102 | | | | | | |
| 58.5 | 17.23 | 1.90 | 258 | 254 | 235 | 216 | 198 | 181 | 164 | 150 | 136 | 124 | 113 | | | | | | |
| 55.0 | 16.25 | 2.39 | 244 | 244 | 243 | 229 | 215 | 201 | 188 | 174 | 162 | 150 | 139 | | | | | | |
| 61.5 | 18.04 | 2.41 | 271 | 271 | 271 | 256 | 240 | 224 | 209 | 195 | 181 | 168 | 156 | 145 | 135 | | | | |
| 67.5 | 19.85 | 2.43 | 298 | 298 | 298 | 282 | 265 | 248 | 232 | 216 | 201 | 186 | 173 | 161 | 150 | | | | |
| 73.5 | 21.66 | 2.44 | 325 | 325 | 325 | 309 | 290 | 272 | 254 | 236 | 220 | 204 | 190 | 177 | 164 | | | | |
| 69.0 | 20.34 | 2.93 | 305 | 305 | 305 | 305 | 296 | 281 | 267 | 252 | 238 | 225 | 212 | 199 | 187 | 166 | 147 | | |
| 76.0 | 22.39 | 2.95 | 336 | 336 | 336 | 336 | 326 | 311 | 295 | 279 | 264 | 249 | 234 | 221 | 208 | 184 | 163 | | |
| 83.0 | 24.45 | 2.97 | 367 | 367 | 367 | 367 | 357 | 340 | 323 | 306 | 289 | 273 | 257 | 242 | 228 | 202 | 179 | | |
| 90.0 | 26 52 | 2.98 | 398 | 398 | 398 | 398 | 388 | 369 | 351 | 333 | 314 | 297 | 280 | 264 | 248 | 220 | 195 | | |
| 14″ BETHLEHEM H COLUMNS 14″ Nominal Flange Width | | | | | | | | | | | | | | | | | | | |
| 84.0 | 24.76 | 3.45 | 371 | 371 | 371 | 371 | 371 | 366 | 351 | 336 | 321 | 306 | 292 | 278 | 264 | 238 | 215 | 194 | |
| 92.0 | 27.05 | 3.47 | 406 | 406 | 406 | 406 | 406 | 401 | 385 | 368 | 352 | 336 | 320 | 305 | 290 | 262 | 236 | 213 | |
| 100.0 | 29.36 | 3.49 | 440 | 440 | 440 | 440 | 440 | 436 | 418 | 401 | 383 | 366 | 349 | 332 | 316 | 285 | 257 | 233 | |
| 107.5 | 31.67 | 3.50 | 475 | 475 | 475 | 475 | 475 | 471 | 452 | 433 | 414 | 396 | 377 | 359 | 342 | 309 | 279 | 252 | |
| 115.5 | 34.00 | 3.52 | 510 | 510 | 510 | 510 | 510 | 506 | 486 | 466 | 446 | 426 | 407 | 387 | 369 | 333 | 301 | 272 | |
| 123.5 | 36.33 | 3.54 | 545 | 545 | 545 | 545 | 545 | 542 | 521 | 500 | 478 | 457 | 436 | 415 | 395 | 358 | 323 | 292 | |
| 131.5 | 38.68 | 3.55 | 580 | 580 | 580 | 580 | 580 | 577 | 555 | 533 | 510 | 487 | 465 | 443 | 422 | 382 | 345 | 312 | |
| 139.0 | 40.88 | 3.57 | 613 | 613 | 613 | 613 | 613 | 612 | 588 | 565 | 540 | 517 | 493 | 470 | 448 | 406 | 367 | 332 | |
| 147.0 | 43.25 | 3.58 | 649 | 649 | 649 | 649 | 649 | 647 | 623 | 598 | 573 | 548 | 523 | 499 | 475 | 430 | 389 | 352 | |
| 155.0 | 45.62 | 3.60 | 684 | 684 | 684 | 684 | 684 | 684 | 659 | 632 | 606 | 579 | 553 | 528 | 503 | 456 | 413 | 374 | |
| 161.0 | 47.33 | 3.80 | 710 | 710 | 710 | 710 | 710 | 710 | 697 | 672 | 646 | 620 | 594 | 568 | 544 | 496 | 452 | 411 | |
| 168.0 | 49.51 | 3.82 | 743 | 743 | 743 | 743 | 743 | 743 | 731 | 705 | 677 | 650 | 623 | 597 | 571 | 521 | 475 | 432 | |
| 177.0 | 51.99 | 3.83 | 780 | 780 | 780 | 780 | 780 | 780 | 768 | 740 | 712 | 684 | 656 | 628 | 600 | 548 | 500 | 455 | |
| 185.0 | 54.48 | 3.84 | 817 | 817 | 817 | 817 | 817 | 817 | 806 | 777 | 747 | 718 | 688 | 659 | 630 | 576 | 525 | 478 | |
| 194.0 | 56.99 | 3.86 | 855 | 855 | 855 | 855 | 855 | 855 | 845 | 814 | 784 | 753 | 722 | 692 | 662 | 605 | 552 | 503 | |
| 202.0 | 59.50 | 3.87 | 893 | 893 | 893 | 893 | 893 | 893 | 882 | 851 | 819 | 787 | 755 | 724 | 692 | 632 | 577 | 527 | |
| 210.0 | 61.86 | 3.88 | 928 | 928 | 928 | 928 | 928 | 928 | 918 | 886 | 852 | 819 | 786 | 753 | 721 | 659 | 602 | 549 | 500 |
| 219.0 | 64.40 | 3.89 | 966 | 966 | 966 | 966 | 966 | 966 | 957 | 923 | 888 | 854 | 820 | 786 | 752 | 688 | 628 | 573 | 523 |
| 227.0 | 66.94 | 3.91 | 1004 | 1004 | 1004 | 1004 | 1004 | 1004 | 996 | 961 | 926 | 890 | 854 | 819 | 785 | 718 | 656 | 598 | 546 |
| 236.0 | 69.49 | 3.92 | 1042 | 1042 | 1042 | 1042 | 1042 | 1042 | 1035 | 999 | 962 | 925 | 888 | 852 | 816 | 747 | 682 | 623 | 569 |
| 245.0 | 72.05 | 3.93 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1074 | 1038 | 999 | 960 | 922 | 885 | 847 | 776 | 709 | 648 | 592 |
| 254.0 | 74.62 | 3.94 | 1119 | 1119 | 1119 | 1119 | 1119 | 1119 | 1113 | 1075 | 1036 | 996 | 957 | 918 | 879 | 805 | 736 | 672 | 614 |
| 262.0 | 77.20 | 3.96 | 1158 | 1158 | 1158 | 1158 | 1158 | 1158 | 1154 | 1115 | 1075 | 1033 | 993 | 953 | 913 | 836 | 765 | 699 | 638 |
| 271.0 | 79.79 | 3.97 | 1197 | 1197 | 1197 | 1197 | 1197 | 1197 | 1194 | 1153 | 1111 | 1069 | 1028 | 986 | 945 | 866 | 792 | 724 | 662 |
| 280.0 | 82.39 | 3.98 | 1236 | 1236 | 1236 | 1236 | 1236 | 1236 | 1233 | 1191 | 1149 | 1106 | 1062 | 1020 | 978 | 896 | 821 | 750 | 685 |
| 289.0 | 85.01 | 3.99 | 1275 | 1275 | 1275 | 1275 | 1275 | 1275 | 1274 | 1231 | 1187 | 1142 | 1097 | 1053 | 1011 | 927 | 848 | 775 | 709 |
| 298.0 | 87.63 | 4.01 | 1314 | 1314 | 1314 | 1314 | 1314 | 1314 | 1314 | 1272 | 1226 | 1180 | 1135 | 1089 | 1045 | 959 | 878 | 804 | 735 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 14" ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Rtr. | I | S | r | I | S | r |
| **14" BETHLEHEM H COLUMNS 8—10 and 12" Nominal Flange Widths** | | | | | | | | | | | | | | | | | |
| 43.0 | 13.375 | 8.00 | .31 | 12.240 | .567 | .491 | .60 | 11.063 | 5½ | ½ | 1" | 408.2 | 61.0 | 5.70 | 43.6 | 10.9 | 1.86 |
| 48.0 | 13.500 | 8.04 | .35 | 12.240 | .630 | .553 | .60 | 11.063 | 5½ | 9/16 | 1" | 461.5 | 68.4 | 5.72 | 49.7 | 12.4 | 1.88 |
| 53.5 | 13.625 | 8.08 | .39 | 12.240 | .692 | .616 | .60 | 11.063 | 5½ | 5/8 | 1" | 516.2 | 75.8 | 5.74 | 56.0 | 13.9 | 1.89 |
| 58.5 | 13.750 | 8.12 | .43 | 12.240 | .755 | .678 | .60 | 11.063 | 5½ | 11/16 | 1" | 572.2 | 83.2 | 5.76 | 62.4 | 15.4 | 1.90 |
| 55.0 | 13.500 | 10.00 | .35 | 12.240 | .630 | .533 | .60 | 11.063 | 5½ | 9/16 | 1" | 551.0 | 81.6 | 5.82 | 93.1 | 18.6 | 2.39 |
| 61.5 | 13.625 | 10.04 | .39 | 12.240 | .692 | .596 | .60 | 11.063 | 5½ | 5/8 | 1" | 616.9 | 90.6 | 5.85 | 104.8 | 20.9 | 2.41 |
| 67.5 | 13.750 | 10.08 | .43 | 12.240 | .755 | .658 | .60 | 11.063 | 5½ | 11/16 | 1" | 684.3 | 99.5 | 5.87 | 116.8 | 23.2 | 2.43 |
| 73.5 | 13.875 | 10.12 | .47 | 12.240 | .817 | .721 | .60 | 11.063 | 5½ | ¾ | 1" | 753.3 | 108.6 | 5.90 | 129.1 | 25.5 | 2.44 |
| 69.0 | 13.625 | 12.00 | .39 | 12.240 | .692 | .576 | .60 | 11.063 | 9" | 5/8 | 1" | 714.6 | 104.9 | 5.93 | 174.7 | 29.1 | 2.93 |
| 76.0 | 13.750 | 12.04 | .43 | 12.240 | .755 | .639 | .60 | 11.063 | 9" | 11/16 | 1" | 793.5 | 115.4 | 5.95 | 194.7 | 32.3 | 2.95 |
| 83.0 | 13.875 | 12.08 | .47 | 12.240 | .817 | .701 | .60 | 11.063 | 9" | ¾ | 1" | 874.2 | 126.0 | 5.98 | 215.1 | 35.6 | 2.97 |
| 90.0 | 14.000 | 12.12 | .51 | 12.240 | .880 | .764 | .60 | 11.063 | 9" | 13/16 | 1" | 956.7 | 136.7 | 6.01 | 235.8 | 38.9 | 2.98 |
| **14" BETHLEHEM H COLUMNS 14" Nominal Flange Width** | | | | | | | | | | | | | | | | | |
| 84.0 | 13.750 | 13.92 | .43 | 12.240 | .755 | .620 | .60 | 11.063 | 10" | 11/16 | 1" | 895.5 | 130.2 | 6.01 | 294.5 | 42.3 | 3.45 |
| 92.0 | 13.875 | 13.96 | .47 | 12.240 | .817 | .683 | .60 | 11.063 | 10" | ¾ | 1" | 987.4 | 142.3 | 6.04 | 325.5 | 46.6 | 3.47 |
| 100.0 | 14.000 | 14.00 | .51 | 12.240 | .880 | .745 | .60 | 11.063 | 10" | 13/16 | 1" | 1081.2 | 154.5 | 6.07 | 356.9 | 51.0 | 3.49 |
| 107.5 | 14.125 | 14.04 | .55 | 12.240 | .942 | .808 | .60 | 11.063 | 10" | 7/8 | 1" | 1177.2 | 166.7 | 6.10 | 388.9 | 55.4 | 3.50 |
| 115.5 | 14.250 | 14.08 | .59 | 12.240 | 1.005 | .870 | .60 | 11.063 | 10" | 15/16 | 1" | 1275.1 | 179 0 | 6.12 | 421.4 | 59.9 | 3.52 |
| 123.5 | 14.375 | 14.12 | .63 | 12.240 | 1.067 | .933 | .60 | 11.063 | 10" | 1" | 1" | 1375.1 | 191.3 | 6.15 | 454.4 | 64.4 | 3.54 |
| 131.5 | 14.500 | 14.16 | .67 | 12.240 | 1.130 | .995 | .60 | 11.063 | 10" | 1 1/16 | 1" | 1477.3 | 203.8 | 6.18 | 488.0 | 68.9 | 3.55 |
| 139.0 | 14.625 | 14.19 | .70 | 12.240 | 1.192 | 1 058 | .60 | 11.063 | 10" | 1 1/8 | 1" | 1578.9 | 215.9 | 6.21 | 520.9 | 73.4 | 3.57 |
| 147.0 | 14.750 | 14.23 | .74 | 12.240 | 1.255 | 1.120 | .60 | 11.063 | 10" | 1 3/16 | 1" | 1685.3 | 228.5 | 6.24 | 555.5 | 78.1 | 3.58 |
| 155.0 | 14.875 | 14.27 | .78 | 12.240 | 1.317 | 1.183 | .60 | 11.063 | 10" | 1 1/4 | 1" | 1793.8 | 241.2 | 6.27 | 590.6 | 82.8 | 3.60 |
| 161.0 | 14.875 | 15.00 | .78 | 12.240 | 1.317 | 1.175 | .60 | 11.063 | 10" | 1 1/4 | 1" | 1874.4 | 252.0 | 6.29 | 682.5 | 91.0 | 3.80 |
| 168.0 | 15.000 | 15.02 | .80 | 12.240 | 1.380 | 1.237 | .60 | 11.063 | 10" | 1 5/16 | 1" | 1984.6 | 264.6 | 6.33 | 720.6 | 96.0 | 3.82 |
| 177.0 | 15.125 | 15.06 | .84 | 12.240 | 1.442 | 1.300 | .60 | 11.063 | 10" | 1 3/8 | 1" | 2102.6 | 278.0 | 6.36 | 762.1 | 101.2 | 3.83 |
| 185.0 | 15.250 | 15.10 | .88 | 12.240 | 1.505 | 1.362 | .60 | 11.063 | 10" | 1 7/16 | 1" | 2223.0 | 291.5 | 6.39 | 804.2 | 106.5 | 3.84 |
| 194.0 | 15.375 | 15.14 | .92 | 12.240 | 1.567 | 1.425 | .60 | 11.063 | 10" | 1 1/2 | 1" | 2345.8 | 305.1 | 6.42 | 846.9 | 111.9 | 3.86 |
| 202.0 | 15.500 | 15.18 | .96 | 12.240 | 1.630 | 1.487 | .60 | 11.063 | 10" | 1 9/16 | 1" | 2470.9 | 318.8 | 6.44 | 890.3 | 117.3 | 3.87 |
| 210.0 | 15.625 | 15.21 | .99 | 12.240 | 1.692 | 1.550 | .60 | 11.063 | 10" | 1 5/8 | 1" | 2595.4 | 332.2 | 6.48 | 932.4 | 122 6 | 3 88 |
| 219.0 | 15.750 | 15.25 | 1.03 | 12.240 | 1.755 | 1.612 | .60 | 11.063 | 10" | 1 11/16 | 1" | 2725.3 | 346.1 | 6.51 | 976.9 | 128.1 | 3.89 |
| 227.0 | 15.875 | 15.29 | 1.07 | 12.240 | 1.817 | 1.675 | .60 | 11.063 | 10" | 1 ¾ | 1" | 2857.8 | 360.0 | 6.53 | 1022.0 | 133.7 | 3.91 |
| 236.0 | 16.000 | 15.33 | 1.11 | 12.240 | 1.880 | 1.737 | .60 | 11.063 | 10" | 1 13/16 | 1" | 2992.9 | 374.1 | 6.56 | 1067.8 | 139.3 | 3.92 |
| 245.0 | 16.125 | 15.37 | 1.15 | 12.240 | 1.942 | 1.800 | .60 | 11.063 | 10" | 1 7/8 | 1" | 3130.4 | 388.3 | 6.59 | 1114.2 | 145.0 | 3.93 |
| 254.0 | 16.250 | 15.41 | 1.19 | 12.240 | 2.005 | 1.862 | .60 | 11.063 | 10" | 1 15/16 | 1" | 3270.6 | 402.5 | 6.62 | 1161.2 | 150.7 | 3.94 |
| 262.0 | 16.375 | 15.45 | 1.23 | 12.240 | 2.067 | 1.925 | .60 | 11.063 | 10" | 2" | 1" | 3413.4 | 416.9 | 6.65 | 1209.0 | 156.5 | 3.96 |
| 271.0 | 16.500 | 15.49 | 1.27 | 12.240 | 2.130 | 1.987 | .60 | 11.063 | 10" | 2 1/16 | 1" | 3558.8 | 431.4 | 6.68 | 1257.3 | 162.3 | 3.97 |
| 280.0 | 16.625 | 15.53 | 1.31 | 12.240 | 2.192 | 2.050 | .60 | 11.063 | 10" | 2 1/8 | 1" | 3706.9 | 445.9 | 6.71 | 1306.4 | 168.2 | 3.98 |
| 289.0 | 16.750 | 15.57 | 1.35 | 12.240 | 2.255 | 2.112 | .60 | 11.063 | 10" | 2 3/16 | 1" | 3857.7 | 460.6 | 6.74 | 1356.1 | 174.2 | 3.99 |
| 298.0 | 16.875 | 15.61 | 1.39 | 12.240 | 2.317 | 2.175 | .60 | 11.063 | 10" | 2 ¼ | 1" | 4011.3 | 475.4 | 6.77 | 1406.5 | 180.2 | 4.01 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

14"

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14" BETHLEHEM H COLUMNS WITH COVER PLATES

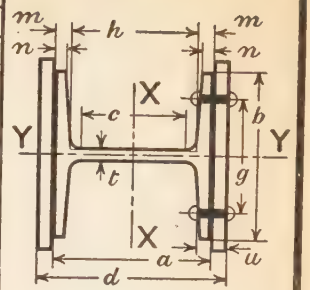
| 2 Cover Plates | Weight per foot | Area Square Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 |
| **14″ × 262# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 17 × 3/8 | 305 | 89.95 | 4.11 | 1349 | 1317 | 1272 | 1227 | 1181 | 1135 | 1090 | 1046 | 1003 | 962 | 921 | 882 | 845 | 809 | 774 |
| 7/16 | 313 | 92.08 | 4.13 | 1381 | 1351 | 1305 | 1258 | 1212 | 1165 | 1120 | 1075 | 1030 | 988 | 947 | 907 | 868 | 831 | 797 |
| 1/2 | 320 | 94.20 | 4.14 | 1413 | 1383 | 1336 | 1289 | 1242 | 1194 | 1147 | 1102 | 1057 | 1013 | 971 | 930 | 891 | 853 | 817 |
| 9/16 | 327 | 96.33 | 4.16 | 1445 | 1417 | 1370 | 1321 | 1273 | 1224 | 1177 | 1130 | 1085 | 1039 | 997 | 955 | 915 | 877 | 840 |
| 5/8 | 334 | 98.45 | 4.18 | 1477 | 1450 | 1403 | 1353 | 1304 | 1255 | 1207 | 1159 | 1112 | 1067 | 1023 | 981 | 939 | 900 | 862 |
| 17 × 11/16 | 342 | 100.58 | 4.20 | 1509 | 1485 | 1435 | 1386 | 1336 | 1285 | 1236 | 1188 | 1141 | 1094 | 1049 | 1006 | 964 | 924 | 885 |
| 3/4 | 349 | 102.70 | 4.21 | 1541 | 1517 | 1468 | 1416 | 1365 | 1315 | 1264 | 1215 | 1167 | 1119 | 1073 | 1029 | 986 | 946 | 906 |
| 13/16 | 356 | 104.83 | 4.23 | 1572 | 1551 | 1500 | 1449 | 1397 | 1346 | 1295 | 1244 | 1195 | 1147 | 1101 | 1055 | 1012 | 970 | 930 |
| 7/8 | 363 | 106.95 | 4.24 | 1604 | 1584 | 1533 | 1480 | 1427 | 1374 | 1323 | 1272 | 1221 | 1172 | 1125 | 1078 | 1034 | 991 | 951 |
| 15/16 | 370 | 109.08 | 4.26 | 1636 | 1619 | 1565 | 1512 | 1458 | 1405 | 1353 | 1301 | 1249 | 1200 | 1151 | 1104 | 1058 | 1016 | 974 |
| **14″ × 298# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 18 × 5/8 | 375 | 110.13 | 4.28 | 1652 | 1637 | 1584 | 1531 | 1477 | 1423 | 1369 | 1317 | 1265 | 1216 | 1166 | 1119 | 1073 | 1031 | 988 |
| 11/16 | 382 | 112.38 | 4.30 | 1686 | 1672 | 1619 | 1565 | 1510 | 1456 | 1401 | 1349 | 1296 | 1245 | 1196 | 1147 | 1100 | 1056 | 1013 |
| 3/4 | 390 | 114.63 | 4.32 | 1719 | 1709 | 1655 | 1600 | 1544 | 1490 | 1434 | 1380 | 1326 | 1275 | 1224 | 1175 | 1127 | 1082 | 1039 |
| 13/16 | 397 | 116.88 | 4.33 | 1753 | 1744 | 1689 | 1633 | 1577 | 1521 | 1465 | 1408 | 1355 | 1302 | 1251 | 1200 | 1151 | 1106 | 1061 |
| 18 × 7/8 | 405 | 119.13 | 4.35 | 1787 | 1780 | 1725 | 1668 | 1611 | 1553 | 1496 | 1440 | 1385 | 1332 | 1279 | 1228 | 1178 | 1132 | 1086 |
| 15/16 | 413 | 121.38 | 4.37 | 1821 | 1816 | 1760 | 1702 | 1645 | 1586 | 1528 | 1472 | 1415 | 1362 | 1308 | 1256 | 1205 | 1158 | 1112 |
| 1 | 420 | 123.63 | 4.39 | 1854 | 1853 | 1796 | 1737 | 1679 | 1620 | 1561 | 1503 | 1446 | 1391 | 1338 | 1285 | 1234 | 1184 | 1137 |
| 1 1/16 | 428 | 125.88 | 4.40 | 1888 | 1888 | 1830 | 1771 | 1712 | 1652 | 1592 | 1533 | 1475 | 1419 | 1365 | 1310 | 1259 | 1208 | 1161 |
| 1 1/8 | 436 | 128.13 | 4.42 | 1922 | 1922 | 1866 | 1807 | 1746 | 1685 | 1625 | 1566 | 1507 | 1449 | 1394 | 1339 | 1286 | 1235 | 1186 |
| 19 × 1 1/8 | 443 | 130.38 | 4.54 | 1956 | 1956 | 1918 | 1859 | 1799 | 1739 | 1679 | 1619 | 1562 | 1503 | 1447 | 1392 | 1340 | 1288 | 1239 |
| 1 3/16 | 451 | 132.75 | 4.56 | 1991 | 1991 | 1955 | 1896 | 1836 | 1775 | 1714 | 1654 | 1594 | 1536 | 1479 | 1423 | 1369 | 1317 | 1266 |
| 1 1/4 | 460 | 135.13 | 4.58 | 2027 | 2027 | 1995 | 1934 | 1873 | 1811 | 1749 | 1688 | 1627 | 1569 | 1511 | 1454 | 1399 | 1346 | 1295 |
| 1 5/16 | 468 | 137.50 | 4.60 | 2063 | 2063 | 2032 | 1972 | 1910 | 1847 | 1785 | 1722 | 1661 | 1601 | 1543 | 1485 | 1429 | 1375 | 1323 |
| 1 3/8 | 476 | 139.88 | 4.61 | 2098 | 2098 | 2069 | 2007 | 1944 | 1881 | 1817 | 1754 | 1693 | 1631 | 1571 | 1514 | 1456 | 1402 | 1348 |
| 19 × 1 7/16 | 484 | 142.25 | 4.63 | 2134 | 2134 | 2108 | 2044 | 1982 | 1916 | 1852 | 1790 | 1725 | 1664 | 1603 | 1543 | 1487 | 1431 | 1377 |
| 1 1/2 | 492 | 144.63 | 4.65 | 2169 | 2169 | 2146 | 2083 | 2018 | 1953 | 1887 | 1824 | 1760 | 1697 | 1636 | 1575 | 1517 | 1461 | 1406 |
| 1 9/16 | 500 | 147.00 | 4.66 | 2205 | 2205 | 2183 | 2118 | 2052 | 1986 | 1921 | 1856 | 1790 | 1727 | 1664 | 1604 | 1545 | 1486 | 1432 |
| 1 5/8 | 508 | 149.38 | 4.67 | 2241 | 2241 | 2220 | 2154 | 2088 | 2021 | 1955 | 1888 | 1822 | 1758 | 1694 | 1633 | 1573 | 1513 | 1458 |
| 1 11/16 | 516 | 151.75 | 4.69 | 2276 | 2276 | 2258 | 2193 | 2126 | 2058 | 1991 | 1923 | 1856 | 1791 | 1727 | 1665 | 1602 | 1543 | 1486 |
| 19 × 1 3/4 | 524 | 154.13 | 4.70 | 2312 | 2312 | 2295 | 2229 | 2161 | 2093 | 2024 | 1956 | 1888 | 1822 | 1757 | 1692 | 1631 | 1571 | 1512 |
| 1 13/16 | 532 | 156.50 | 4.71 | 2348 | 2348 | 2332 | 2265 | 2196 | 2127 | 2058 | 1988 | 1920 | 1853 | 1786 | 1722 | 1659 | 1598 | 1538 |
| 1 7/8 | 540 | 158.88 | 4.73 | 2383 | 2383 | 2372 | 2304 | 2234 | 2164 | 2094 | 2024 | 1954 | 1886 | 1819 | 1754 | 1690 | 1629 | 1568 |
| 1 15/16 | 548 | 161.25 | 4.74 | 2419 | 2419 | 2409 | 2340 | 2269 | 2198 | 2127 | 2056 | 1987 | 1917 | 1850 | 1782 | 1719 | 1654 | 1595 |
| 2 | 556 | 163.63 | 4.75 | 2454 | 2454 | 2446 | 2376 | 2306 | 2234 | 2162 | 2090 | 2019 | 1949 | 1880 | 1811 | 1748 | 1682 | 1622 |

Loads to right of heavy vertical lines are for Secondary Members ONLY. For 14″ Bethlehem 149# Special H Column with cover plates see following pages.

# DIMENSIONS AND FUNCTIONS OF 14″ BETHLEHEM H COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per foot | DIMENSIONS d | b | t | a | h | m | n | c | g | u | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14″ × 262# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 17 × 3/8 | 305 | 17 1/8 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 3/8 | 1″ | 4307.8 | 503.1 | 6.92 | 1516.0 | 178.4 | 4.11 |
| 7/16 | 313 | 17 1/4 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 7/16 | 1″ | 4464.8 | 517.7 | 6.96 | 1567.2 | 184.4 | 4.13 |
| 1/2 | 320 | 17 3/8 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 1/2 | 1″ | 4624.0 | 532.3 | 7.01 | 1618.4 | 190.4 | 4.14 |
| 9/16 | 327 | 17 1/2 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2 067 | 1.925 | 11 1/16 | 10″ | 2 9/16 | 1″ | 4785.5 | 546.9 | 7.05 | 1669.6 | 196.4 | 4.16 |
| 5/8 | 334 | 17 5/8 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 5/8 | 1″ | 4949.4 | 561.6 | 7.09 | 1720.7 | 202.4 | 4.18 |
| 17 × 11/16 | 342 | 17 3/4 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 11/16 | 1″ | 5115.6 | 576.4 | 7.13 | 1771.9 | 208.5 | 4.20 |
| 3/4 | 349 | 17 7/8 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 3/4 | 1″ | 5284.1 | 591.2 | 7.17 | 1823.1 | 214.5 | 4.21 |
| 13/16 | 356 | 18″ | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 13/16 | 1″ | 5455.1 | 606.1 | 7.21 | 1874.3 | 220.5 | 4.23 |
| 7/8 | 363 | 18 1/8 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 7/8 | 1″ | 5628.4 | 621.1 | 7.25 | 1925.4 | 226.5 | 4.24 |
| 15/16 | 370 | 18 1/4 | 15.45 | 1.23 | 16 3/8 | 12.24 | 2.067 | 1.925 | 11 1/16 | 10″ | 2 15/16 | 1″ | 5804.1 | 636.1 | 7.29 | 1976.6 | 232.5 | 4.26 |
| **14″ × 298# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 18 × 5/8 | 375 | 18 1/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 2 7/8 | 1″ | 5734.7 | 632.8 | 7.22 | 2014.0 | 223.8 | 4.28 |
| 11/16 | 382 | 18 1/4 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 2 15/16 | 1″ | 5920.7 | 648.8 | 7.26 | 2074.7 | 230.5 | 4.30 |
| 3/4 | 390 | 18 3/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3″ | 1″ | 6109.4 | 665.0 | 7.30 | 2135.5 | 237.3 | 4.32 |
| 13/16 | 397 | 18 1/2 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 1/16 | 1″ | 6300.6 | 681.1 | 7.34 | 2196.2 | 244.0 | 4.33 |
| 18 × 7/8 | 405 | 18 5/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 1/8 | 1″ | 6494.4 | 697.4 | 7.38 | 2257.0 | 250.8 | 4.35 |
| 15/16 | 413 | 18 3/4 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 3/16 | 1″ | 6690.8 | 713.7 | 7.42 | 2317.7 | 257.5 | 4.37 |
| 1 | 420 | 18 7/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 1/4 | 1″ | 6889.9 | 730.1 | 7.47 | 2378.5 | 264.3 | 4.39 |
| 1 1/16 | 428 | 19″ | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 5/16 | 1″ | 7091.6 | 746.5 | 7.51 | 2439.2 | 271.0 | 4.40 |
| 1 1/8 | 436 | 19 1/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 3/8 | 1″ | 7296.0 | 763.0 | 7.55 | 2500.0 | 277.8 | 4.42 |
| 19 × 1 1/8 | 443 | 19 1/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 3/8 | 1″ | 7478.5 | 782.1 | 7.57 | 2692.5 | 283.4 | 4.54 |
| 1 3/16 | 451 | 19 1/4 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 7/16 | 1″ | 7697.1 | 799.7 | 7.61 | 2764.0 | 290.9 | 4.56 |
| 1 1/4 | 460 | 19 3/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 1/2 | 1″ | 7918.6 | 817.4 | 7.66 | 2835.4 | 298.5 | 4.58 |
| 1 5/16 | 468 | 19 1/2 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 9/16 | 1″ | 8142.9 | 835.2 | 7.70 | 2906.9 | 306.0 | 4.60 |
| 1 3/8 | 476 | 19 3/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 5/8 | 1″ | 8370.1 | 853.0 | 7.74 | 2978.3 | 313.5 | 4.61 |
| 19 × 1 7/16 | 484 | 19 3/4 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2 317 | 2.175 | 11 1/16 | 10″ | 3 11/16 | 1″ | 8600.3 | 870.9 | 7.78 | 3049.8 | 321.0 | 4.63 |
| 1 1/2 | 492 | 19 7/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 3/4 | 1″ | 8833.3 | 888.9 | 7.82 | 3121.2 | 328.5 | 4.65 |
| 1 9/16 | 500 | 20″ | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 13/16 | 1″ | 9069.4 | 906.9 | 7.85 | 3192.7 | 336.1 | 4.66 |
| 1 5/8 | 508 | 20 1/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 7/8 | 1″ | 9308.3 | 925.1 | 7.89 | 3264.1 | 343.6 | 4.67 |
| 1 11/16 | 516 | 20 1/4 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 3 15/16 | 1″ | 9550.3 | 943.2 | 7.93 | 3335.6 | 351.1 | 4.69 |
| 19 × 1 3/4 | 524 | 20 3/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 4″ | 1″ | 9795.3 | 961.5 | 7.97 | 3407.0 | 358.6 | 4.70 |
| 1 13/16 | 532 | 20 1/2 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2 317 | 2.175 | 11 1/16 | 10″ | 4 1/16 | 1″ | 10043.3 | 979.8 | 8.01 | 3478.5 | 366.2 | 4.71 |
| 1 7/8 | 540 | 20 5/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 4 1/8 | 1″ | 10294.4 | 998.2 | 8.05 | 3549.9 | 373.7 | 4.73 |
| 1 15/16 | 548 | 20 3/4 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 4 3/16 | 1″ | 10548.5 | 1016.7 | 8.09 | 3621.4 | 381.2 | 4.74 |
| 2 | 556 | 20 7/8 | 15.61 | 1.39 | 16 7/8 | 12.24 | 2.317 | 2.175 | 11 1/16 | 10″ | 4 1/4 | 1″ | 10805.7 | 1035.3 | 8.13 | 3692.8 | 388.7 | 4.75 |

For 14″ Bethlehem 149# Special H Column with cover plates see following pages.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

14″

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14" BETHLEHEM SPECIAL H COLUMN WITH COVER PLATES

| 2 Cover Plates | Weight per foot | Area Square Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 48 |
| 14" × 149# BETHLEHEM SPECIAL H COLUMN | | | | | | | | | | | | | | | | | | |
| None | 149. | 43.82 | 3.27 | | | | | | | | | | | | | | | |
| 17 × 1 1/4 | 293.5 | 86.32 | 4.16 | 1295 | 1295 | 1270 | 1227 | 1183 | 1140 | 1097 | 1055 | 1013 | 972 | 931 | 893 | 855 | 820 | 753 |
| 1 5/16 | 300.7 | 88.44 | 4.18 | 1327 | 1327 | 1303 | 1260 | 1215 | 1172 | 1128 | 1084 | 1041 | 999 | 959 | 919 | 881 | 844 | 775 |
| 1 3/8 | 307.9 | 90.57 | 4.20 | 1359 | 1359 | 1337 | 1292 | 1248 | 1203 | 1157 | 1113 | 1070 | 1027 | 985 | 945 | 906 | 868 | 797 |
| 1 7/16 | 315.2 | 92.69 | 4.21 | 1390 | 1390 | 1369 | 1325 | 1278 | 1232 | 1186 | 1141 | 1097 | 1053 | 1010 | 969 | 929 | 890 | 818 |
| 1 1/2 | 322.4 | 94.82 | 4.23 | 1422 | 1422 | 1403 | 1357 | 1310 | 1264 | 1217 | 1171 | 1126 | 1081 | 1037 | 996 | 954 | 925 | 841 |
| 17 × 1 9/16 | 329.6 | 96.94 | 4.25 | 1454 | 1454 | 1437 | 1390 | 1343 | 1295 | 1248 | 1200 | 1155 | 1109 | 1064 | 1021 | 979 | 938 | 864 |
| 1 5/8 | 336.8 | 99.07 | 4.26 | 1486 | 1486 | 1470 | 1422 | 1373 | 1325 | 1276 | 1228 | 1182 | 1134 | 1090 | 1045 | 1003 | 961 | 885 |
| 1 11/16 | 344.1 | 101.19 | 4.28 | 1518 | 1518 | 1504 | 1455 | 1407 | 1357 | 1307 | 1258 | 1210 | 1163 | 1117 | 1072 | 1028 | 986 | 908 |
| 1 3/4 | 351.3 | 103.32 | 4.29 | 1550 | 1550 | 1536 | 1487 | 1437 | 1387 | 1337 | 1286 | 1238 | 1189 | 1143 | 1097 | 1053 | 1009 | 929 |
| 1 13/16 | 358.5 | 105.44 | 4.30 | 1582 | 1582 | 1569 | 1519 | 1469 | 1417 | 1367 | 1315 | 1265 | 1216 | 1168 | 1122 | 1077 | 1032 | 950 |
| 18 × 1 3/4 | 363.2 | 106.82 | 4.51 | 1602 | 1602 | 1602 | 1567 | 1519 | 1469 | 1420 | 1371 | 1321 | 1273 | 1226 | 1180 | 1135 | 1092 | 1008 |
| 1 13/16 | 370.8 | 109.07 | 4.52 | 1636 | 1636 | 1636 | 1602 | 1552 | 1502 | 1452 | 1402 | 1351 | 1302 | 1254 | 1207 | 1162 | 1117 | 1032 |
| 1 7/8 | 378.5 | 111.32 | 4.54 | 1670 | 1670 | 1670 | 1638 | 1587 | 1536 | 1485 | 1434 | 1383 | 1334 | 1284 | 1236 | 1189 | 1144 | 1058 |
| 1 15/16 | 386.1 | 113.57 | 4.55 | 1704 | 1704 | 1704 | 1672 | 1621 | 1568 | 1516 | 1464 | 1413 | 1362 | 1312 | 1263 | 1215 | 1169 | 1081 |
| 2" | 393.8 | 115.82 | 4.56 | 1737 | 1737 | 1737 | 1706 | 1654 | 1602 | 1549 | 1495 | 1443 | 1391 | 1340 | 1290 | 1242 | 1194 | 1105 |
| 18 × 2 1/16 | 401.4 | 118.07 | 4.58 | 1771 | 1771 | 1771 | 1743 | 1690 | 1636 | 1582 | 1528 | 1475 | 1422 | 1371 | 1320 | 1270 | 1222 | 1131 |
| 2 1/8 | 409.1 | 120.32 | 4.59 | 1805 | 1805 | 1805 | 1777 | 1723 | 1669 | 1613 | 1559 | 1505 | 1451 | 1399 | 1348 | 1297 | 1248 | 1155 |
| 2 3/16 | 416.7 | 122.57 | 4.60 | 1839 | 1839 | 1839 | 1812 | 1758 | 1702 | 1646 | 1591 | 1535 | 1481 | 1427 | 1375 | 1324 | 1274 | 1179 |
| 2 1/4 | 424.4 | 124.82 | 4.61 | 1872 | 1872 | 1872 | 1846 | 1791 | 1735 | 1679 | 1621 | 1565 | 1510 | 1455 | 1402 | 1351 | 1299 | 1203 |
| 2 5/16 | 432.0 | 127.07 | 4.62 | 1906 | 1906 | 1906 | 1882 | 1825 | 1768 | 1710 | 1665 | 1596 | 1539 | 1484 | 1430 | 1376 | 1325 | 1227 |
| 19 × 2 1/4 | 439.7 | 129.32 | 4.85 | 1940 | 1940 | 1940 | 1940 | 1893 | 1838 | 1782 | 1726 | 1671 | 1615 | 1561 | 1508 | 1455 | 1403 | 1305 |
| 2 5/16 | 447.8 | 131.69 | 4.86 | 1975 | 1975 | 1975 | 1975 | 1929 | 1873 | 1817 | 1759 | 1704 | 1647 | 1592 | 1538 | 1484 | 1431 | 1331 |
| 2 3/8 | 455.8 | 134.07 | 4.87 | 2011 | 2011 | 2011 | 2011 | 1965 | 1909 | 1852 | 1794 | 1736 | 1679 | 1622 | 1567 | 1514 | 1460 | 1358 |
| 2 7/16 | 463.9 | 136.44 | 4.88 | 2047 | 2047 | 2047 | 2047 | 2002 | 1944 | 1886 | 1827 | 1770 | 1711 | 1654 | 1598 | 1542 | 1489 | 1384 |
| 2 1/2 | 472.0 | 138.82 | 4.89 | 2082 | 2082 | 2082 | 2082 | 2038 | 1980 | 1920 | 1862 | 1802 | 1744 | 1685 | 1627 | 1571 | 1516 | 1410 |
| 19 × 2 9/16 | 480.1 | 141.19 | 4.91 | 2118 | 2118 | 2118 | 2118 | 2075 | 2016 | 1957 | 1898 | 1837 | 1778 | 1718 | 1659 | 1604 | 1547 | 1440 |
| 2 5/8 | 488.1 | 143.57 | 4.92 | 2154 | 2154 | 2154 | 2154 | 2112 | 2053 | 1991 | 1931 | 1869 | 1809 | 1749 | 1690 | 1632 | 1576 | 1467 |
| 2 11/16 | 496.2 | 145.94 | 4.93 | 2189 | 2189 | 2189 | 2189 | 2148 | 2088 | 2027 | 1966 | 1903 | 1842 | 1780 | 1721 | 1662 | 1604 | 1494 |
| 2 3/4 | 504.3 | 148.32 | 4.94 | 2225 | 2225 | 2225 | 2225 | 2185 | 2124 | 2062 | 1999 | 1937 | 1873 | 1812 | 1752 | 1691 | 1633 | 1520 |
| 2 13/16 | 512.4 | 150.69 | 4.94 | 2260 | 2260 | 2260 | 2260 | 2220 | 2158 | 2095 | 2031 | 1968 | 1903 | 1841 | 1780 | 1718 | 1659 | 1545 |
| 2 7/8 | 520.4 | 153.07 | 4.95 | 2296 | 2296 | 2296 | 2296 | 2256 | 2193 | 2129 | 2065 | 2001 | 1936 | 1872 | 1809 | 1748 | 1688 | 1572 |

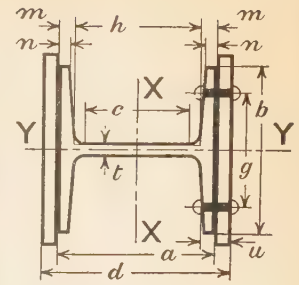
Loads to right of heavy vertical lines are for Secondary Members ONLY.

For 14" Bethlehem 262# and 298# H Columns with cover plates see preceding pages.

# DIMENSIONS AND FUNCTIONS OF 14″ BETHLEHEM SPECIAL H COLUMN WITH COVER PLATES

| 2 Cover Plates | Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | d | b | t | a | h | m | n | c | g | u | Riv. | I | S | r | I | S | r |
| 14″ × 149# BETHLEHEM SPECIAL H COLUMN | | | | | | | | | | | | | | | | | | |
| None | 149.0 | 14 1/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 7/8 | 7/8 | 1379.1 | 195.3 | 5.61 | 468.8 | 62.9 | 3.27 |
| 17 × 1 1/4 | 293.5 | 16 5/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 1/8 | 7/8 | 3896.3 | 468.7 | 6.72 | 1492.4 | 175.6 | 4.16 |
| 1 5/16 | 300.7 | 16 3/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 3/16 | 7/8 | 4044.2 | 482.9 | 6.76 | 1543.5 | 181.6 | 4.18 |
| 1 3/8 | 307.9 | 16 7/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 1/4 | 7/8 | 4194.4 | 497.1 | 6.81 | 1594.7 | 187.6 | 4.20 |
| 1 7/16 | 315.2 | 17″ | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 5/16 | 7/8 | 4346.8 | 511.4 | 6.85 | 1645.9 | 193.6 | 4.21 |
| 1 1/2 | 322.4 | 17 1/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 3/8 | 7/8 | 4501.5 | 525.7 | 6.89 | 1697.1 | 199.7 | 4.23 |
| 17 × 1 9/16 | 329.6 | 17 1/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 7/16 | 7/8 | 4658.4 | 540.1 | 6.93 | 1748.3 | 205.7 | 4.25 |
| 1 5/8 | 336.8 | 17 3/8 | 14 90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 1/2 | 7/8 | 4817.6 | 554.5 | 6.97 | 1799.4 | 211.7 | 4.26 |
| 1 11/16 | 344.1 | 17 1/2 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 9/16 | 7/8 | 4979.2 | 569.0 | 7.01 | 1850.6 | 217.7 | 4.28 |
| 1 3/4 | 351.3 | 17 5/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 5/8 | 7/8 | 5143.0 | 583.6 | 7.06 | 1901.8 | 223.7 | 4.29 |
| 1 13/16 | 358.5 | 17 3/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 11/16 | 7/8 | 5309.2 | 598.2 | 7.10 | 1953.0 | 229.8 | 4.30 |
| 18 × 1 3/4 | 363.2 | 17 5/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 5/8 | 7/8 | 5364.4 | 608.7 | 7.09 | 2169.8 | 241.1 | 4.51 |
| 1 13/16 | 370.8 | 17 3/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 11/16 | 7/8 | 5540.4 | 624 3 | 7.13 | 2230.6 | 247.8 | 4.52 |
| 1 7/8 | 378.5 | 17 7/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 3/4 | 7/8 | 5718.9 | 639.9 | 7.17 | 2291.3 | 254.6 | 4.54 |
| 1 15/16 | 386.1 | 18″ | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 13/16 | 7/8 | 5899.9 | 655.5 | 7.21 | 2352.1 | 261.3 | 4.55 |
| 2″ | 393.8 | 18 1/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 7/8 | 7/8 | 6083.4 | 671.3 | 7.25 | 2412.8 | 268.1 | 4.56 |
| 18 × 2 1/16 | 401.4 | 18 1/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 2 15/16 | 7/8 | 6269.5 | 687.1 | 7.29 | 2473.6 | 274.8 | 4.58 |
| 2 1/8 | 409.1 | 18 3/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3″ | 7/8 | 6458.1 | 702.9 | 7.33 | 2534.3 | 281.6 | 4.59 |
| 2 3/16 | 416.7 | 18 1/2 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 1/16 | 7/8 | 6649.3 | 718.8 | 7.37 | 2595.1 | 288.3 | 4.60 |
| 2 1/4 | 424.4 | 18 5/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 1/8 | 7/8 | 6843.1 | 734.8 | 7.40 | 2655.8 | 295.1 | 4.61 |
| 2 5/16 | 432.0 | 18 3/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 3/16 | 7/8 | 7039.6 | 750.9 | 7.44 | 2716.6 | 301.8 | 4.62 |
| 19 × 2 1/4 | 439.7 | 18 5/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 1/8 | 7/8 | 7146.7 | 767.4 | 7.43 | 3040.9 | 320.1 | 4.85 |
| 2 5/16 | 447.8 | 18 3/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 3/16 | 7/8 | 7354.1 | 784.4 | 7.47 | 3112.4 | 327.6 | 4.86 |
| 2 3/8 | 455.8 | 18 7/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 1/4 | 7/8 | 7564.2 | 801.5 | 7.51 | 3183.8 | 335.1 | 4.87 |
| 2 7/16 | 463.9 | 19″ | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 5/16 | 7/8 | 7777.1 | 818.6 | 7.55 | 3255.3 | 342.7 | 4.88 |
| 2 1/2 | 472.0 | 19 1/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 3/8 | 7/8 | 7992.9 | 835.9 | 7.59 | 3326.7 | 350.2 | 4.89 |
| 19 × 2 9/16 | 480.1 | 19 1/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 7/16 | 7/8 | 8211.5 | 853.1 | 7.63 | 3398.2 | 357.7 | 4.91 |
| 2 5/8 | 488.1 | 19 3/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 1/2 | 7/8 | 8432.9 | 870.5 | 7.66 | 3469.6 | 365.2 | 4.92 |
| 2 11/16 | 496.2 | 19 1/2 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 9/16 | 7/8 | 8657.3 | 887.9 | 7.70 | 3541.1 | 372.7 | 4.93 |
| 2 3/4 | 504.3 | 19 5/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 5/8 | 7/8 | 8884.5 | 905.4 | 7.74 | 3612.5 | 380.3 | 4.94 |
| 2 13/16 | 512.4 | 19 3/4 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 11/16 | 7/8 | 9114.6 | 923.0 | 7.78 | 3684.0 | 387.8 | 4.94 |
| 2 7/8 | 520.4 | 19 7/8 | 14.90 | 1.41 | 14 1/8 | 12.24 | .942 | .808 | 11 1/16 | 10″ | 3 3/4 | 7/8 | 9347.7 | 940.6 | 7.81 | 3755.4 | 395.3 | 4.95 |

For 14″ Bethlehem 262# and 298# H Columns with cover plates see preceding pages.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

14″

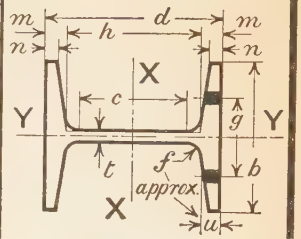
# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 16″ ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per foot | Area Square Inch | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 44 | 48 |
| 16″ BETHLEHEM **H** COLUMNS | | | | | | | | | | | | | | | | | |
| 143.0 | 42.03 | 3.90 | 630 | 630 | 625 | 603 | 580 | 558 | 536 | 514 | 492 | 470 | 450 | 430 | 411 | 375 | 342 |
| 151.0 | 44.56 | 3.92 | 668 | 668 | 664 | 641 | 617 | 593 | 569 | 546 | 523 | 501 | 479 | 458 | 438 | 400 | 365 |
| 160.0 | 47.10 | 3.93 | 707 | 707 | 702 | 678 | 653 | 628 | 603 | 578 | 554 | 530 | 507 | 485 | 463 | 423 | 387 |
| 169.0 | 49.65 | 3.95 | 745 | 745 | 742 | 716 | 690 | 664 | 638 | 612 | 586 | 561 | 537 | 513 | 491 | 448 | 410 |
| 177.0 | 52.20 | 3.96 | 783 | 783 | 780 | 754 | 727 | 698 | 671 | 644 | 617 | 591 | 565 | 541 | 517 | 472 | 432 |
| 186.0 | 54.77 | 3.98 | 822 | 822 | 820 | 792 | 763 | 735 | 706 | 678 | 650 | 622 | 596 | 570 | 546 | 498 | 456 |
| 195.0 | 57.35 | 4.00 | 860 | 860 | 860 | 832 | 801 | 771 | 742 | 712 | 683 | 654 | 626 | 599 | 574 | 524 | 479 |
| 203.0 | 59.94 | 4.01 | 899 | 899 | 899 | 870 | 839 | 807 | 776 | 745 | 715 | 685 | 656 | 628 | 601 | 550 | 503 |
| 212.0 | 62.53 | 4.02 | 938 | 938 | 938 | 909 | 875 | 844 | 811 | 778 | 747 | 716 | 685 | 657 | 628 | 575 | 526 |
| 221.0 | 65.14 | 4.04 | 977 | 977 | 977 | 948 | 914 | 881 | 847 | 814 | 780 | 748 | 717 | 687 | 657 | 602 | 550 |
| 230.0 | 67.60 | 4.05 | 1014 | 1014 | 1014 | 984 | 950 | 915 | 880 | 846 | 811 | 778 | 746 | 714 | 683 | 626 | 573 |
| 238.0 | 70.07 | 4.07 | 1051 | 1051 | 1051 | 1022 | 987 | 951 | 914 | 879 | 844 | 809 | 776 | 743 | 711 | 652 | 597 |
| 247.0 | 72.70 | 4.08 | 1091 | 1091 | 1091 | 1061 | 1025 | 988 | 950 | 913 | 877 | 841 | 806 | 773 | 739 | 678 | 621 |
| 256.0 | 75.35 | 4.10 | 1130 | 1130 | 1130 | 1102 | 1065 | 1026 | 988 | 949 | 912 | 875 | 839 | 804 | 770 | 706 | 647 |
| 265.0 | 78.00 | 4.11 | 1170 | 1170 | 1170 | 1142 | 1103 | 1064 | 1024 | 984 | 945 | 907 | 870 | 834 | 799 | 732 | 672 |
| 274.0 | 80.67 | 4.12 | 1210 | 1210 | 1210 | 1183 | 1142 | 1101 | 1060 | 1020 | 979 | 940 | 901 | 864 | 828 | 759 | 696 |
| 288.0 | 84.69 | 4.14 | 1270 | 1270 | 1270 | 1243 | 1201 | 1159 | 1116 | 1073 | 1032 | 991 | 950 | 910 | 873 | 801 | 734 |
| 301.0 | 88.56 | 4.16 | 1328 | 1328 | 1328 | 1303 | 1259 | 1214 | 1170 | 1126 | 1082 | 1039 | 997 | 956 | 917 | 841 | 772 |
| 314.0 | 92.45 | 4.18 | 1387 | 1387 | 1387 | 1362 | 1317 | 1270 | 1225 | 1179 | 1133 | 1088 | 1045 | 1002 | 961 | 882 | 810 |
| 328.0 | 96.53 | 4.20 | 1448 | 1448 | 1448 | 1425 | 1377 | 1330 | 1282 | 1234 | 1186 | 1140 | 1095 | 1050 | 1007 | 925 | 849 |
| 342.0 | 100.63 | 4.22 | 1509 | 1509 | 1509 | 1487 | 1439 | 1390 | 1339 | 1290 | 1241 | 1192 | 1145 | 1099 | 1055 | 969 | 891 |
| 356.0 | 104.75 | 4.24 | 1571 | 1571 | 1571 | 1551 | 1501 | 1450 | 1397 | 1346 | 1296 | 1245 | 1196 | 1148 | 1102 | 1013 | 931 |
| 370.0 | 108.90 | 4.26 | 1634 | 1634 | 1634 | 1616 | 1563 | 1509 | 1456 | 1403 | 1350 | 1299 | 1247 | 1198 | 1149 | 1056 | 972 |
| 384.0 | 113.07 | 4.27 | 1696 | 1696 | 1696 | 1679 | 1625 | 1569 | 1514 | 1459 | 1404 | 1350 | 1297 | 1246 | 1195 | 1099 | 1012 |
| 399.0 | 117.26 | 4.29 | 1759 | 1759 | 1759 | 1744 | 1687 | 1631 | 1574 | 1517 | 1460 | 1405 | 1350 | 1297 | 1245 | 1146 | 1054 |
| 413.0 | 121.48 | 4.31 | 1822 | 1822 | 1822 | 1810 | 1753 | 1695 | 1635 | 1577 | 1517 | 1460 | 1403 | 1348 | 1295 | 1192 | 1097 |
| 427.0 | 125.72 | 4.33 | 1886 | 1886 | 1886 | 1876 | 1817 | 1756 | 1696 | 1636 | 1575 | 1515 | 1457 | 1401 | 1345 | 1238 | 1142 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 16″ ROLLED COLUMNS BETHLEHEM SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **16″ BETHLEHEM H COLUMNS** | | | | | | | | | | | | | | | | | |
| 143.0 | 14.500 | 15.54 | .72 | 12.240 | 1.130 | .982 | .60 | 11.063 | 10″ | 1 1/16 | 1″ | 1610.4 | 222.1 | 6.19 | 638.9 | 82.2 | 3.90 |
| 151.0 | 14.625 | 15.58 | .76 | 12.240 | 1.193 | 1.044 | .60 | 11.063 | 10″ | 1 1/8 | 1″ | 1723.8 | 235.7 | 6.22 | 683.4 | 87.7 | 3.92 |
| 160.0 | 14.750 | 15.62 | .80 | 12.240 | 1.255 | 1.107 | .60 | 11.063 | 10″ | 1 3/16 | 1″ | 1839.5 | 249.4 | 6.25 | 728.5 | 93.3 | 3.93 |
| 169.0 | 14.875 | 15.66 | .84 | 12.240 | 1.318 | 1.169 | .60 | 11.063 | 10″ | 1 1/4 | 1″ | 1957.6 | 263.2 | 6.28 | 774.2 | 98.9 | 3.95 |
| 177.0 | 15.000 | 15.70 | .88 | 12.240 | 1.380 | 1.232 | .60 | 11.063 | 10″ | 1 5/16 | 1″ | 2078.0 | 277.1 | 6.31 | 820.7 | 104.5 | 3.96 |
| 186.0 | 15.125 | 15.74 | .92 | 12.240 | 1.443 | 1.294 | .60 | 11.063 | 10″ | 1 3/8 | 1″ | 2200.9 | 291.0 | 6.34 | 867.7 | 110.3 | 3.98 |
| 195.0 | 15.250 | 15.78 | .96 | 12.240 | 1.505 | 1.357 | .60 | 11.063 | 10″ | 1 7/16 | 1″ | 2326.1 | 305.1 | 6.37 | 915.5 | 116.0 | 4.00 |
| 203.0 | 15.375 | 15.82 | 1.00 | 12.240 | 1.568 | 1.419 | .60 | 11.063 | 10″ | 1 1/2 | 1″ | 2453.9 | 319.2 | 6.40 | 963.9 | 121.9 | 4.01 |
| 212.0 | 15.500 | 15.86 | 1.04 | 12.240 | 1.630 | 1.482 | .60 | 11.063 | 10″ | 1 9/16 | 1″ | 2584.1 | 333.4 | 6.43 | 1013.0 | 127.7 | 4.02 |
| 221.0 | 15.625 | 15.90 | 1.08 | 12.240 | 1.693 | 1.544 | .60 | 11.063 | 10″ | 1 5/8 | 1″ | 2716.9 | 347.8 | 6.46 | 1062.7 | 133.7 | 4.04 |
| 230.0 | 15.750 | 15.93 | 1.11 | 12.240 | 1.755 | 1.607 | .60 | 11.063 | 10″ | 1 11/16 | 1″ | 2848.9 | 361.8 | 6.49 | 1111.0 | 139.5 | 4.05 |
| 238.0 | 15.875 | 15.96 | 1.14 | 12.240 | 1.818 | 1.669 | .60 | 11.063 | 10″ | 1 3/4 | 1″ | 2983.4 | 375.9 | 6.53 | 1159.8 | 145.3 | 4.07 |
| 247.0 | 16.000 | 16.00 | 1.18 | 12.240 | 1.880 | 1.732 | .60 | 11.063 | 10″ | 1 13/16 | 1″ | 3123.7 | 390.5 | 6.55 | 1211.4 | 151.4 | 4.08 |
| 256.0 | 16.125 | 16.04 | 1.22 | 12.240 | 1.943 | 1.794 | .60 | 11.063 | 10″ | 1 7/8 | 1″ | 3266.7 | 405.2 | 6.58 | 1263.8 | 157.6 | 4.10 |
| 265.0 | 16.250 | 16.08 | 1.26 | 12.240 | 2.005 | 1.857 | .60 | 11.063 | 10″ | 1 15/16 | 1″ | 3412.4 | 420.0 | 6.61 | 1316.8 | 163.8 | 4.11 |
| 274.0 | 16.375 | 16.12 | 1.30 | 12.240 | 2.068 | 1.919 | .60 | 11.063 | 10″ | 2″ | 1″ | 3560.7 | 434.9 | 6.64 | 1370.6 | 170.0 | 4.12 |
| 288.0 | 16.563 | 16.18 | 1.36 | 12.240 | 2.161 | 2.013 | .60 | 11.063 | 10″ | 2 1/16 | 1″ | 3788.4 | 457.5 | 6.69 | 1452.5 | 179.5 | 4.14 |
| 301.0 | 16.750 | 16.23 | 1.41 | 12.240 | 2.255 | 2.107 | .60 | 11.063 | 10″ | 2 3/16 | 1″ | 4018.4 | 479.8 | 6.74 | 1533.2 | 188.9 | 4.16 |
| 314.0 | 16.938 | 16.28 | 1.46 | 12.240 | 2.349 | 2.201 | .60 | 11.063 | 10″ | 2 1/4 | 1″ | 4254.5 | 502.4 | 6.78 | 1615.2 | 198.4 | 4.18 |
| 328.0 | 17.125 | 16.34 | 1.52 | 12.240 | 2.443 | 2.294 | .60 | 11.063 | 10″ | 2 3/8 | 1″ | 4500.9 | 525.7 | 6.83 | 1701.8 | 208.3 | 4.20 |
| 342.0 | 17.313 | 16.40 | 1.58 | 12.240 | 2.536 | 2.388 | .60 | 11.063 | 10″ | 2 7/16 | 1″ | 4754.0 | 549.2 | 6.87 | 1790.1 | 218.3 | 4.22 |
| 356.0 | 17.500 | 16.46 | 1.64 | 12.240 | 2.630 | 2.482 | .60 | 11.063 | 10″ | 2 9/16 | 1″ | 5013.7 | 573.0 | 6.92 | 1880.0 | 228.4 | 4.24 |
| 370.0 | 17.688 | 16.52 | 1.70 | 12.240 | 2.724 | 2.576 | .60 | 11.063 | 10″ | 2 5/8 | 1″ | 5280.2 | 597.1 | 6.96 | 1971.7 | 238.7 | 4.26 |
| 384.0 | 17.875 | 16.58 | 1.76 | 12.240 | 2.818 | 2.669 | .60 | 11.063 | 10″ | 2 3/4 | 1″ | 5553.6 | 621.4 | 7.01 | 2065.1 | 249.1 | 4.27 |
| 399.0 | 18.063 | 16.64 | 1.82 | 12.240 | 2.911 | 2.763 | .60 | 11.063 | 10″ | 2 13/16 | 1″ | 5834.0 | 646.0 | 7.05 | 2160.3 | 259.6 | 4.29 |
| 413.0 | 18.250 | 16.70 | 1.88 | 12.240 | 3.005 | 2.857 | .60 | 11.063 | 10″ | 2 15/16 | 1″ | 6121.5 | 670.8 | 7.10 | 2257.2 | 270.3 | 4.31 |
| 427.0 | 18.438 | 16.76 | 1.94 | 12.240 | 3.099 | 2.951 | .60 | 11.063 | 10″ | 3″ | 1″ | 6416.2 | 696.0 | 7.14 | 2355.9 | 281.1 | 4.33 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

16″

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 16" BETHLEHEM H COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per Foot | Area Square Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 48 |
| **16" × 293# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 18 × 5/8 | 370 | 108.74 | 4.36 | 1631 | 1631 | 1626 | 1576 | 1523 | 1471 | 1420 | 1368 | 1317 | 1267 | 1218 | 1170 | 1123 | 1078 | 994 |
| 11/16 | 377 | 110.99 | 4.38 | 1665 | 1665 | 1663 | 1612 | 1558 | 1506 | 1453 | 1400 | 1349 | 1296 | 1248 | 1199 | 1151 | 1105 | 1019 |
| 3/4 | 385 | 113.24 | 4.40 | 1699 | 1699 | 1699 | 1647 | 1593 | 1540 | 1486 | 1432 | 1379 | 1327 | 1276 | 1228 | 1179 | 1132 | 1044 |
| 18 × 13/16 | 392 | 115.49 | 4.42 | 1732 | 1732 | 1732 | 1682 | 1628 | 1574 | 1519 | 1464 | 1411 | 1358 | 1306 | 1257 | 1207 | 1160 | 1069 |
| 7/8 | 400 | 117.74 | 4.43 | 1766 | 1766 | 1766 | 1715 | 1661 | 1606 | 1549 | 1495 | 1441 | 1387 | 1334 | 1282 | 1233 | 1184 | 1093 |
| 15/16 | 408 | 119.99 | 4.45 | 1800 | 1800 | 1800 | 1752 | 1697 | 1640 | 1584 | 1527 | 1472 | 1417 | 1364 | 1311 | 1261 | 1212 | 1118 |
| 18 × 1 | 415 | 122.24 | 4.46 | 1834 | 1834 | 1834 | 1786 | 1730 | 1672 | 1616 | 1559 | 1502 | 1446 | 1392 | 1339 | 1287 | 1237 | 1142 |
| 1 1/16 | 423 | 124.49 | 4.48 | 1867 | 1867 | 1867 | 1823 | 1765 | 1707 | 1649 | 1591 | 1534 | 1478 | 1422 | 1368 | 1316 | 1265 | 1168 |
| 1 1/8 | 431 | 126.74 | 4.49 | 1901 | 1901 | 1901 | 1857 | 1798 | 1739 | 1681 | 1622 | 1564 | 1506 | 1450 | 1395 | 1342 | 1290 | 1191 |
| **16" × 363# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 18 × 5/8 | 440 | 129.36 | 4.42 | 1940 | 1940 | 1940 | 1883 | 1824 | 1763 | 1701 | 1640 | 1581 | 1521 | 1463 | 1407 | 1352 | 1299 | 1198 |
| 11/16 | 447 | 131.61 | 4.43 | 1974 | 1974 | 1974 | 1918 | 1857 | 1795 | 1732 | 1671 | 1611 | 1550 | 1491 | 1433 | 1378 | 1324 | 1221 |
| 3/4 | 455 | 133.86 | 4.44 | 2008 | 2008 | 2008 | 1953 | 1891 | 1829 | 1764 | 1703 | 1641 | 1580 | 1519 | 1460 | 1404 | 1349 | 1245 |
| 18 × 13/16 | 463 | 136.11 | 4.46 | 2042 | 2042 | 2042 | 1989 | 1926 | 1862 | 1799 | 1735 | 1673 | 1610 | 1550 | 1490 | 1433 | 1377 | 1271 |
| 7/8 | 470 | 138.36 | 4.47 | 2075 | 2075 | 2075 | 2023 | 1959 | 1894 | 1831 | 1765 | 1703 | 1640 | 1579 | 1518 | 1460 | 1403 | 1295 |
| 15/16 | 478 | 140.61 | 4.48 | 2109 | 2109 | 2109 | 2059 | 1994 | 1928 | 1863 | 1797 | 1732 | 1669 | 1606 | 1545 | 1486 | 1429 | 1319 |
| 18 × 1 | 486 | 142.86 | 4.49 | 2143 | 2143 | 2143 | 2093 | 2027 | 1960 | 1894 | 1829 | 1763 | 1697 | 1634 | 1573 | 1513 | 1454 | 1343 |
| 1 1/16 | 493 | 145.11 | 4.51 | 2177 | 2177 | 2177 | 2129 | 2063 | 1995 | 1929 | 1862 | 1795 | 1730 | 1666 | 1603 | 1543 | 1483 | 1370 |
| 1 1/8 | 501 | 147.36 | 4.52 | 2210 | 2210 | 2210 | 2165 | 2097 | 2029 | 1961 | 1894 | 1826 | 1759 | 1695 | 1631 | 1569 | 1509 | 1394 |
| 19 × 1 1/8 | 509 | 149.61 | 4.63 | 2244 | 2244 | 2244 | 2217 | 2150 | 2084 | 2015 | 1948 | 1882 | 1815 | 1750 | 1686 | 1623 | 1563 | 1448 |
| 1 3/16 | 517 | 151.99 | 4.64 | 2280 | 2280 | 2280 | 2254 | 2186 | 2119 | 2049 | 1980 | 1914 | 1847 | 1780 | 1716 | 1652 | 1591 | 1474 |
| 1 1/4 | 525 | 154.36 | 4.65 | 2315 | 2315 | 2315 | 2291 | 2223 | 2153 | 2084 | 2014 | 1946 | 1879 | 1811 | 1746 | 1681 | 1619 | 1500 |
| 19 × 1 5/16 | 533 | 156.74 | 4.67 | 2351 | 2351 | 2351 | 2329 | 2260 | 2191 | 2121 | 2052 | 1981 | 1912 | 1845 | 1777 | 1713 | 1650 | 1530 |
| 1 3/8 | 541 | 159.11 | 4.68 | 2387 | 2387 | 2387 | 2366 | 2298 | 2226 | 2156 | 2084 | 2014 | 1944 | 1874 | 1807 | 1742 | 1677 | 1555 |
| 1 7/16 | 549 | 161.49 | 4.69 | 2422 | 2422 | 2422 | 2403 | 2334 | 2262 | 2190 | 2119 | 2046 | 1975 | 1906 | 1838 | 1772 | 1705 | 1581 |
| 19 × 1 1/2 | 557 | 163.86 | 4.71 | 2458 | 2458 | 2458 | 2442 | 2371 | 2299 | 2227 | 2155 | 2081 | 2011 | 1940 | 1870 | 1802 | 1737 | 1611 |
| 1 9/16 | 565 | 166.24 | 4.72 | 2494 | 2494 | 2494 | 2479 | 2407 | 2334 | 2263 | 2188 | 2115 | 2041 | 1970 | 1900 | 1832 | 1765 | 1637 |
| 1 5/8 | 573 | 168.61 | 4.73 | 2529 | 2529 | 2529 | 2517 | 2445 | 2371 | 2296 | 2222 | 2148 | 2074 | 2001 | 1931 | 1861 | 1794 | 1664 |

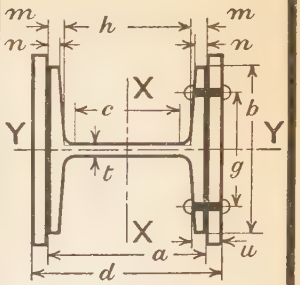
Loads to right of heavy vertical lines are for Secondary Members ONLY.

For 16" Bethlehem H Columns with 20" cover plates see following pages.

# DIMENSIONS AND FUNCTIONS OF 16″ BETHLEHEM H COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per Foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | d | b | t | a | h | m | n | c | g | u | Riv. | I | S | r | I | S | r |
| **16″ × 293# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 18 × 5/8 | 370 | 17 5/8 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 2 5/8 | 1″ | 5311.5 | 602.7 | 6.99 | 2069.5 | 229.9 | 4.36 |
| 11/16 | 377 | 17 3/4 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 2 11/16 | 1″ | 5487.5 | 618.3 | 7.03 | 2130.2 | 236.7 | 4.38 |
| 3/4 | 385 | 17 7/8 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 2 3/4 | 1″ | 5665.9 | 633.9 | 7.07 | 2191.0 | 243.4 | 4.40 |
| 18 × 13/16 | 392 | 18 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 2 13/16 | 1″ | 5846.9 | 649.7 | 7.12 | 2251.7 | 250.2 | 4.42 |
| 7/8 | 400 | 18 1/8 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 2 7/8 | 1″ | 6030.4 | 665.4 | 7.16 | 2312.5 | 256.9 | 4.43 |
| 15/16 | 408 | 18 1/4 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 2 15/16 | 1″ | 6216.5 | 681.3 | 7.20 | 2373.2 | 263.7 | 4.45 |
| 18 × 1 | 415 | 18 3/8 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 3 | 1″ | 6405.1 | 697.2 | 7.24 | 2434.0 | 270.4 | 4.46 |
| 1 1/16 | 423 | 18 1/2 | 16.46 | 1.64 | 16 3/8 | 12.24 | 2.068 | 1.919 | 11 1/16 | 10″ | 3 1/16 | 1″ | 6596.4 | 713.1 | 7.28 | 2494.7 | 277.2 | 4.48 |
| 1 1/8 | 431 | 18 5/8 | 16.46 | 1.64 | 16 3/8 | 12 24 | 2.068 | 1.919 | 11 1/16 | 10″ | 3 1/8 | 1″ | 6790.2 | 729.1 | 7.32 | 2555.5 | 283.9 | 4.49 |
| **16″ × 363# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 18 × 5/8 | 440 | 18 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 3/16 | 10″ | 3 1/16 | 1″ | 6720.2 | 724.1 | 7.21 | 2522.0 | 280.2 | 4.42 |
| 11/16 | 447 | 18 11/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 1/8 | 1″ | 6915.4 | 740.1 | 7.25 | 2582 8 | 287.0 | 4.43 |
| 3/4 | 455 | 18 13/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/15 | 10″ | 3 3/16 | 1″ | 7113.1 | 756.2 | 7.29 | 2643.5 | 293.7 | 4.44 |
| 18 × 13/16 | 463 | 18 15/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 1/4 | 1″ | 7313.5 | 772.4 | 7.33 | 2704.3 | 300.5 | 4.46 |
| 7/8 | 470 | 19 1/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 5/16 | 1″ | 7516.6 | 788.6 | 7.37 | 2765.0 | 307.2 | 4.47 |
| 15/16 | 478 | 19 3/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 3/8 | 1″ | 7722.3 | 804.9 | 7.41 | 2825.8 | 314.0 | 4.48 |
| 18 × 1 | 486 | 19 5/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 7/16 | 1″ | 7930.8 | 821.3 | 7.45 | 2886.5 | 320.7 | 4.49 |
| 1 1/16 | 493 | 19 7/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 1/2 | 1″ | 8141.9 | 837.8 | 7.49 | 2947.3 | 327.5 | 4.51 |
| 1 1/8 | 501 | 19 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 9/16 | 1″ | 8355.8 | 854.3 | 7.53 | 3008.0 | 334.2 | 4.52 |
| 19 × 1 1/8 | 509 | 19 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 9/16 | 1″ | 8547.3 | 873.8 | 7.56 | 3200.6 | 336.9 | 4.63 |
| 1 3/16 | 517 | 19 11/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 5/8 | 1″ | 8775.9 | 891.5 | 7.60 | 3272.0 | 344.4 | 4.64 |
| 1 1/4 | 525 | 19 13/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 11/16 | 1″ | 9007.5 | 909.3 | 7.64 | 3343.5 | 351.9 | 4.65 |
| 19 × 1 5/16 | 533 | 19 15/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 3/4 | 1″ | 9242.1 | 927.1 | 7.68 | 3414.9 | 359.5 | 4.67 |
| 1 3/8 | 541 | 20 1/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 13/16 | 1″ | 9479.6 | 945.0 | 7.72 | 3486.4 | 367.0 | 4.68 |
| 1 7/16 | 549 | 20 3/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 7/8 | 1″ | 9720.1 | 963.0 | 7.76 | 3557.8 | 374.5 | 4.69 |
| 19 × 1 1/2 | 557 | 20 5/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 3 15/16 | 1″ | 9963.5 | 981.0 | 7.80 | 3629.3 | 382.0 | 4.71 |
| 1 9/16 | 565 | 20 7/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4″ | 1″ | 10210.0 | 999.1 | 7.84 | 3700.7 | 389.5 | 4.72 |
| 1 5/8 | 573 | 20 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 1/16 | 1″ | 10459.6 | 1017.3 | 7.88 | 3772.2 | 397.1 | 4.73 |

For 16″ Bethlehem H Columns with 20″ cover plates see following pages.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

16″

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 16" BETHLEHEM H COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per Foot | Area Square Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 |
| 16" × 363# BETHLEHEM H COLUMN | | | | | | | | | | | | | | | | | | |
| 20 × 1 5/8 | 584 | 171.86 | 4 87 | 2578 | 2578 | 2519 | 2447 | 2373 | 2299 | 2226 | 2152 | 2080 | 2009 | 1940 | 1872 | 1805 | 1741 | 1679 |
| 1 11/16 | 593 | 174.36 | 4 89 | 2615 | 2615 | 2560 | 2486 | 2411 | 2338 | 2263 | 2190 | 2117 | 2043 | 1974 | 1904 | 1838 | 1771 | 1709 |
| 1 3/4 | 601 | 176.86 | 4.90 | 2653 | 2653 | 2598 | 2524 | 2448 | 2373 | 2297 | 2223 | 2149 | 2075 | 2006 | 1935 | 1868 | 1800 | 1737 |
| 20 × 1 13/16 | 610 | 179.36 | 4.91 | 2690 | 2690 | 2637 | 2561 | 2486 | 2411 | 2333 | 2258 | 2183 | 2107 | 2038 | 1966 | 1898 | 1829 | 1765 |
| 1 7/8 | 618 | 181.86 | 4.93 | 2728 | 2728 | 2677 | 2602 | 2525 | 2450 | 2371 | 2295 | 2219 | 2144 | 2071 | 1999 | 1930 | 1862 | 1795 |
| 1 15/16 | 627 | 184.36 | 4.94 | 2765 | 2765 | 2716 | 2640 | 2563 | 2485 | 2408 | 2328 | 2253 | 2177 | 2102 | 2030 | 1958 | 1890 | 1823 |
| 20 × 2 | 635 | 186.86 | 4.95 | 2803 | 2803 | 2754 | 2678 | 2599 | 2521 | 2442 | 2364 | 2285 | 2209 | 2134 | 2061 | 1988 | 1919 | 1852 |
| 2 1/16 | 644 | 189.36 | 4 96 | 2840 | 2840 | 2795 | 2715 | 2638 | 2556 | 2479 | 2399 | 2320 | 2242 | 2166 | 2092 | 2019 | 1949 | 1880 |
| 2 1/8 | 652 | 191.86 | 4.97 | 2878 | 2878 | 2834 | 2753 | 2675 | 2594 | 2513 | 2433 | 2352 | 2275 | 2199 | 2122 | 2049 | 1978 | 1909 |
| 20 × 2 3/16 | 661 | 194.36 | 4.99 | 2915 | 2915 | 2875 | 2795 | 2713 | 2632 | 2550 | 2470 | 2391 | 2311 | 2233 | 2157 | 2082 | 2010 | 1940 |
| 2 1/4 | 669 | 196.86 | 5 00 | 2953 | 2953 | 2914 | 2833 | 2752 | 2669 | 2587 | 2504 | 2423 | 2345 | 2266 | 2187 | 2112 | 2039 | 1969 |
| 2 5/16 | 678 | 199.36 | 5.01 | 2990 | 2990 | 2953 | 2871 | 2789 | 2705 | 2622 | 2538 | 2456 | 2376 | 2297 | 2219 | 2143 | 2069 | 1998 |
| 20 × 2 3/8 | 686 | 201.86 | 5.02 | 3028 | 3028 | 2992 | 2909 | 2826 | 2741 | 2658 | 2574 | 2491 | 2410 | 2329 | 2251 | 2174 | 2099 | 2027 |
| 2 7/16 | 695 | 204.36 | 5.03 | 3065 | 3065 | 3031 | 2949 | 2863 | 2779 | 2693 | 2610 | 2526 | 2442 | 2362 | 2283 | 2203 | 2127 | 2054 |
| 2 1/2 | 703 | 206.86 | 5.04 | 3103 | 3103 | 3070 | 2987 | 2900 | 2815 | 2728 | 2644 | 2559 | 2474 | 2393 | 2313 | 2234 | 2158 | 2083 |
| 20 × 2 9/16 | 712 | 209.36 | 5.05 | 3140 | 3140 | 3109 | 3025 | 2939 | 2851 | 2766 | 2680 | 2594 | 2508 | 2426 | 2345 | 2265 | 2188 | 2112 |
| 2 5/8 | 720 | 211.86 | 5.06 | 3178 | 3178 | 3148 | 3063 | 2977 | 2888 | 2801 | 2714 | 2627 | 2542 | 2458 | 2375 | 2294 | 2216 | 2140 |
| 2 11/16 | 729 | 214.36 | 5.06 | 3215 | 3215 | 3185 | 3100 | 3012 | 2922 | 2834 | 2746 | 2658 | 2572 | 2487 | 2403 | 2322 | 2242 | 2165 |
| 20 × 2 3/4 | 737 | 216.86 | 5.07 | 3253 | 3253 | 3225 | 3138 | 3049 | 2960 | 2871 | 2782 | 2693 | 2607 | 2520 | 2435 | 2353 | 2273 | 2195 |
| 2 13/16 | 746 | 219.36 | 5.08 | 3290 | 3290 | 3264 | 3176 | 3086 | 2996 | 2907 | 2817 | 2727 | 2639 | 2553 | 2468 | 2384 | 2303 | 2224 |
| 2 7/8 | 754 | 221.86 | 5.09 | 3328 | 3328 | 3303 | 3215 | 3126 | 3033 | 2942 | 2850 | 2760 | 2671 | 2585 | 2498 | 2414 | 2332 | 2254 |
| 20 × 2 15/16 | 763 | 224.36 | 5.10 | 3365 | 3365 | 3343 | 3253 | 3163 | 3071 | 2980 | 2888 | 2796 | 2706 | 2618 | 2531 | 2446 | 2363 | 2284 |
| 3 | 771 | 226.86 | 5.11 | 3403 | 3403 | 3382 | 3292 | 3201 | 3108 | 3015 | 2922 | 2829 | 2738 | 2650 | 2561 | 2477 | 2393 | 2312 |

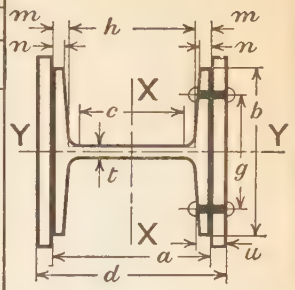
Loads to right of heavy vertical lines are for Secondary Members ONLY.

For 16" Bethlehem H Columns with 18" and 19" cover plates see preceding pages.

# DIMENSIONS AND FUNCTIONS OF 16″ BETHLEHEM H COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per Foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | d | b | t | a | h | m | n | c | g | u | Riv. | I | S | r | I | S | r |
| **16″ × 363# BETHLEHEM H COLUMN** | | | | | | | | | | | | | | | | | | |
| 20 × 1 5/8 | 584 | 20 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 1/16 | 1″ | 10752 | 1045.7 | 7.91 | 4081.2 | 408.1 | 4.87 |
| 1 11/16 | 593 | 20 11/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 1/8 | 1″ | 11018 | 1065.1 | 7.95 | 4164.5 | 416.5 | 4.89 |
| 1 3/4 | 601 | 20 13/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 3/16 | 1″ | 11287 | 1084.6 | 7.99 | 4247.8 | 424.8 | 4.90 |
| 20 × 1 13/16 | 610 | 20 15/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 1/4 | 1″ | 11559 | 1104.1 | 8.03 | 4331.2 | 433.1 | 4.91 |
| 1 7/8 | 618 | 21 1/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 5/16 | 1″ | 11835 | 1123.8 | 8.07 | 4414.5 | 441.5 | 4.93 |
| 1 15/16 | 627 | 21 3/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 3/8 | 1″ | 12114 | 1143.5 | 8.11 | 4497.8 | 449.8 | 4.94 |
| 20 × 2 | 635 | 21 5/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 7/16 | 1″ | 12396 | 1163.2 | 8.14 | 4581.2 | 458.1 | 4.95 |
| 2 1/16 | 644 | 21 7/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 1/2 | 1″ | 12681 | 1183.1 | 8.18 | 4664.5 | 466.5 | 4.96 |
| 2 1/8 | 652 | 21 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 9/16 | 1″ | 12970 | 1203.0 | 8.22 | 4747.8 | 474.8 | 4.97 |
| 20 × 2 3/16 | 661 | 21 11/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 5/8 | 1″ | 13262 | 1223.0 | 8.26 | 4831.2 | 483.1 | 4.99 |
| 2 1/4 | 669 | 21 13/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 11/16 | 1″ | 13558 | 1243.2 | 8.30 | 4914.5 | 491.5 | 5.00 |
| 2 5/16 | 678 | 21 15/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 3/4 | 1″ | 13857 | 1263.3 | 8.34 | 4997.8 | 499.8 | 5.01 |
| 20 × 2 3/8 | 686 | 22 1/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 13/16 | 1″ | 14160 | 1283.6 | 8.38 | 5081.2 | 508.1 | 5.02 |
| 2 7/16 | 695 | 22 3/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 7/8 | 1″ | 14466 | 1303.9 | 8.41 | 5164.5 | 516.5 | 5.03 |
| 2 1/2 | 703 | 22 5/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 4 15/16 | 1″ | 14775 | 1324.4 | 8.45 | 5247.8 | 524.8 | 5.04 |
| 20 × 2 9/16 | 712 | 22 7/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 | 1″ | 15088 | 1344.9 | 8.49 | 5331.2 | 533.1 | 5.05 |
| 2 5/8 | 720 | 22 9/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 1/16 | 1″ | 15404 | 1365.5 | 8.53 | 5414.5 | 541.5 | 5.06 |
| 2 11/16 | 729 | 22 11/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 1/8 | 1″ | 15724 | 1386.2 | 8.56 | 5497.8 | 549.8 | 5.06 |
| 20 × 2 3/4 | 737 | 22 13/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2 536 | 2.388 | 11 1/16 | 10″ | 5 3/16 | 1″ | 16048 | 1406.9 | 8.60 | 5581.2 | 558.1 | 5.07 |
| 2 13/16 | 746 | 22 15/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 1/4 | 1″ | 16375 | 1427.8 | 8.64 | 5664.5 | 566.5 | 5.08 |
| 2 7/8 | 754 | 23 1/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 5/16 | 1″ | 16705 | 1448.7 | 8.68 | 5747.8 | 574.8 | 5.09 |
| 20 × 2 15/16 | 763 | 23 3/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 3/8 | 1″ | 17040 | 1469.7 | 8.71 | 5831.2 | 583.1 | 5.10 |
| 3 | 771 | 23 5/16 | 16.76 | 1.94 | 17 5/16 | 12.24 | 2.536 | 2.388 | 11 1/16 | 10″ | 5 7/16 | 1″ | 17378 | 1490.8 | 8.75 | 5914.5 | 591.5 | 5.11 |

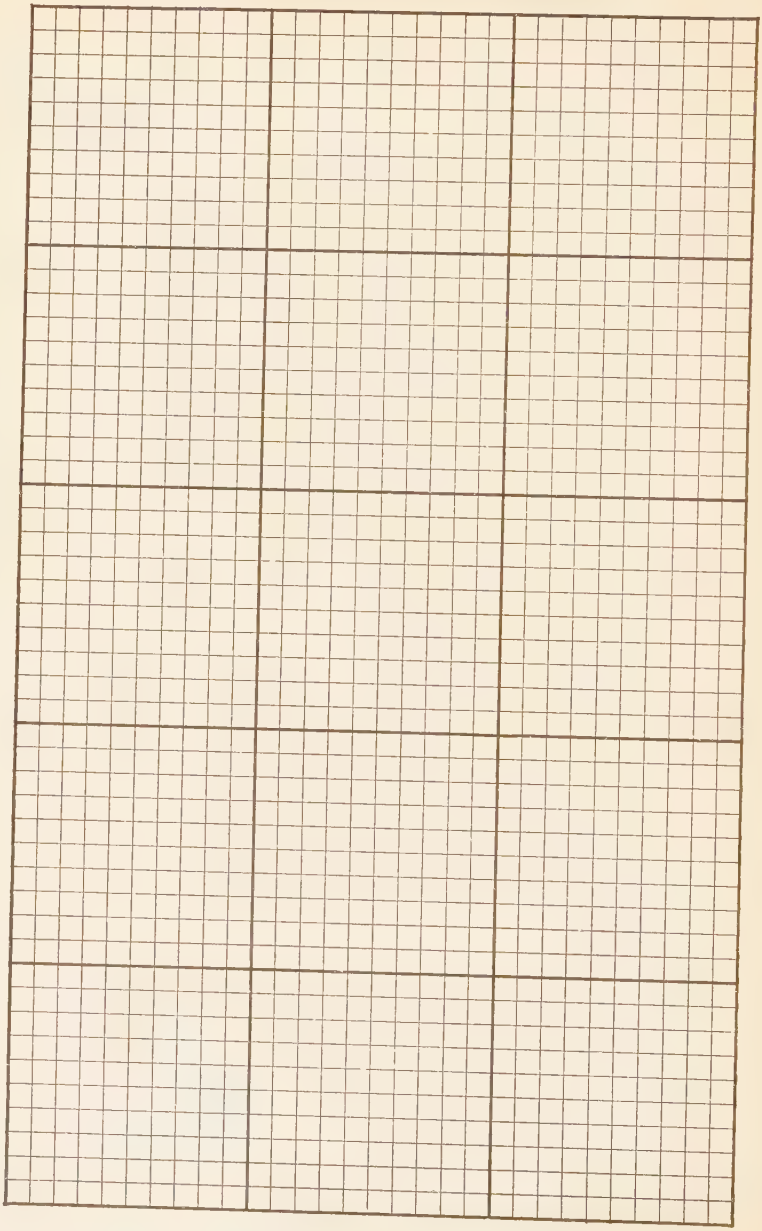
For 16″ Bethlehem H Columns with 18″ and 19″ cover plates see preceding pages.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

16″

## NOTES and DIAGRAMS



# Part IV

# Section 12

## CARNEGIE BEAM COLUMN SECTIONS

### Dimensions—Technical Functions

### Allowable Concentric Loads by A. I. S. C. Specification

| Manufacturers Section Index | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sec. Index | Depth | Weight | | | | | | | | | | | |
| H 1 | 4″ | 13.8 | | | | | | | | | | | |
| H 2 | 5″ | 18.9 | | | | | | | | | | | |
| H 3 | 6″ | 20 0 | 22.5 | | | | | | | | | | |
| H 3A | 6″ | 25 0 | 27.5 | | | | | | | | | | |
| CB 61 | 6″ | 40 0 | 50 0 | 60 0 | 70.0 | 80 0 | 88 0 | | | | | | |
| B 39 | 8″ | 17 5 | 21 0 | | | | | | | | | | |
| H 4 | 8″ | 32 6 | 34 3 | 37 7 | | | | | | | | | |
| CB 82 | 8″ | 24 0 | 27 0 | 30 0 | | | | | | | | | |
| CB 83 | 8″ | 31 0 | 36 0 | 42.0 | 48.0 | 54 0 | 60.0 | 66 0 | 72 0 | 78 0 | 84 0 | 90.0 | |
| B 40 | 9″ | 20 5 | 25 0 | | | | | | | | | | |
| CB 92 | 9″ | 29.0 | 32.0 | 35.0 | | | | | | | | | |
| CB 93 | 9″ | 38.0 | 43.0 | 48.0 | | | | | | | | | |
| CB 101 | 10″ | 21.0 | 23 0 | 26.0 | 30 0 | | | | | | | | |
| CB 102 | 10″ | 31 0 | 36 0 | 42 0 | | | | | | | | | |
| CB 103A | 10″ | 49 0 | 54 0 | 59 0 | 64 0 | | | | | | | | |
| CB 104 | 10″ | 70 0 | 77 0 | 84 0 | 92 0 | | | | | | | | |
| CB 105 | 10′ | 100 0 | 108.0 | 116.0 | 124.0 | 132.0 | 140.0 | | | | | | |
| CB 121 | 12″ | 25.0 | | | | | | | | | | | |
| CB 122 | 12″ | 28 0 | 32 0 | 34 0 | 36 0 | | | | | | | | |
| CB 123 | 12″ | 40 0 | 45 0 | 50 0 | | | | | | | | | |
| CB 123B | 12″ | 55 0 | 60 0 | 66 0 | | | | | | | | | |
| CB 124B | 12″ | 65 0 | 70 0 | 76 0 | | | | | | | | | |
| CB 124C | 12″ | 82 0 | 88 0 | 95 0 | 102 0 | | | | | | | | |
| CB 125 | 12″ | 110 0 | 120 0 | 130 0 | 140 0 | | | | | | | | |
| CB 126 | 12″ | 150 0 | 160 0 | 170 0 | 180 0 | | | | | | | | |
| CB 127 | 12″ | 190 0 | 200 0 | 210 0 | 220 0 | 230 0 | | | | | | | |
| CB 141 | 14″ | 30.0 | | | | | | | | | | | |
| CB 142 | 14″ | 33.0 | 36 0 | 38.0 | 39 0 | 42 0 | | | | | | | |
| CB 143 | 14″ | 48.0 | 53 0 | 58 0 | | | | | | | | | |
| CB 144 | 14″ | 61.0 | 68 0 | 75 0 | | | | | | | | | |
| CB 145 | 14″ | 85.0 | 95 0 | 105 0 | | | | | | | | | |
| CB 146 | 14″ | 86 0 | 96 0 | 106 0 | 115 0 | 125 0 | 131.0 | 135 0 | 145.0 | 155.0 | 165 0 | 175.0 | 185.0 |
| CB 146 | 14″ | 195.0 | 205.0 | 215.0 | 225 0 | 235 0 | 245.0 | 255.0 | 265.0 | 275 0 | 285.0 | 295.0 | 305 0 |
| CB 146 | 14″ | 325.0 | 345.0 | 365.0 | 385.0 | 405 0 | 425.0 | | | | | | |

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 4", 5", 6", 8", AND 9" ROLLED COLUMNS

CARNEGIE SMALL AND SPECIAL SECTIONS

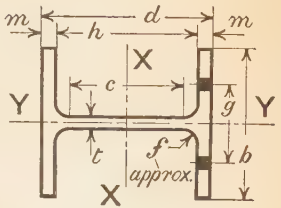
| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 |
| **4" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 13.8 | 3.99 | 0.95 | 60 | 54 | 46 | 42 | 38 | 35 | 32 | 29 | 26 | 24 | | | | | | | | | | |
| **5" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 18.9 | 5.47 | 1.20 | 82 | 82 | 73 | 68 | 63 | 59 | 55 | 51 | 47 | 44 | 41 | 38 | 35 | 33 | 31 | | | | | |
| **6" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 20.0 | 5.86 | 1.39 | 88 | 88 | 83 | 79 | 75 | 70 | 66 | 62 | 58 | 55 | 51 | 48 | 45 | 42 | 40 | 35 | | | | |
| 22.5 | 6.61 | 1.36 | 99 | 99 | 93 | 88 | 83 | 78 | 73 | 69 | 64 | 60 | 56 | 53 | 50 | 46 | 44 | 38 | | | | |
| 25.0 | 7.33 | 1.43 | 110 | 110 | 106 | 100 | 95 | 90 | 84 | 79 | 75 | 70 | 66 | 62 | 58 | 55 | 51 | 46 | | | | |
| 27.5 | 8.08 | 1.41 | 121 | 121 | 116 | 110 | 104 | 98 | 92 | 87 | 81 | 76 | 72 | 67 | 63 | 59 | 56 | 49 | | | | |
| **6" CARNEGIE SPECIAL BEAM SECTIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 40.0 | 11.76 | 2.43 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 172 | 167 | 162 | 157 | 152 | 147 | 142 | 137 | 128 | 119 | 110 | 103 | 95 |
| 50.0 | 14.70 | 2.48 | 221 | 221 | 221 | 221 | 221 | 221 | 221 | 217 | 211 | 205 | 198 | 192 | 186 | 180 | 174 | 162 | 151 | 141 | 131 | 122 |
| 60.0 | 17.63 | 2.51 | 264 | 264 | 264 | 264 | 264 | 264 | 264 | 261 | 254 | 247 | 239 | 232 | 225 | 218 | 211 | 197 | 183 | 171 | 159 | 148 |
| 70.0 | 20.58 | 2.54 | 309 | 309 | 309 | 309 | 309 | 309 | 309 | 306 | 298 | 290 | 281 | 273 | 264 | 256 | 248 | 232 | 216 | 201 | 188 | 175 |
| 80.0 | 23.52 | 2.58 | 353 | 353 | 353 | 353 | 353 | 353 | 353 | 352 | 343 | 333 | 324 | 314 | 305 | 295 | 286 | 268 | 250 | 234 | 218 | 203 |
| 88.0 | 25.87 | 2.60 | 388 | 388 | 388 | 388 | 388 | 388 | 388 | 388 | 378 | 368 | 357 | 347 | 337 | 326 | 316 | 296 | 277 | 259 | 242 | 226 |
| **8" CARNEGIE MILL SECTIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 17.5 | 5.14 | 1.08 | 77 | 74 | 64 | 59 | 55 | 51 | 47 | 43 | 39 | 36 | 34 | 31 | | | | | | | | |
| 21.0 | 6.17 | 1.03 | 93 | 87 | 75 | 69 | 63 | 58 | 53 | 49 | 45 | 41 | 38 | 35 | | | | | | | | |
| **8" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 32.6 | 9.50 | 1.90 | 143 | 143 | 143 | 143 | 140 | 135 | 130 | 124 | 119 | 114 | 109 | 104 | 100 | 95 | 91 | 83 | 75 | 68 | 62 | 57 |
| 34.3 | 10.00 | 1.87 | 150 | 150 | 150 | 150 | 146 | 141 | 136 | 130 | 124 | 119 | 114 | 108 | 103 | 99 | 94 | 85 | 78 | 71 | 64 | 59 |
| 37.7 | 11.00 | 1.83 | 165 | 165 | 165 | 165 | 160 | 154 | 147 | 141 | 135 | 129 | 123 | 117 | 112 | 106 | 101 | 92 | 83 | 76 | 69 | 63 |
| **9" CARNEGIE MILL SECTIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 20.5 | 6.02 | 1.15 | 90 | 89 | 78 | 73 | 68 | 63 | 58 | 54 | 50 | 46 | 43 | 39 | 37 | 34 | | | | | | |
| 25.0 | 7.34 | 1.09 | 110 | 106 | 92 | 85 | 79 | 73 | 67 | 62 | 57 | 53 | 49 | 45 | 42 | | | | | | | |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 4", 5", 6", 8" AND 9" ROLLED COLUMNS

CARNEGIE SMALL AND SPECIAL SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **4" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | |
| 13 8 | 4 000 | 4 000 | .313 | 3 094 | .453 | .290 | .31 | 2.522 | 2¼ | ⅜ | ¾ | 10.7 | 5.35 | 1.64 | 3.6 | 1.80 | 0 95 |
| **5" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | |
| 18 9 | 5 000 | 5 000 | .313 | 3.994 | .503 | .330 | .31 | 3 413 | 2¾ | 13/32 | ¾ | 23.8 | 9.52 | 2.08 | 7 8 | 3.12 | 1.20 |
| **6" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | |
| 20 0 | 6.000 | 5 938 | .250 | 5.042 | .479 | .280 | 31 | 4.458 | 3½ | ⅜ | ¾ | 38 8 | 12.93 | 2.57 | 11.4 | 3.84 | 1.39 |
| 22 5 | 6.000 | 6 063 | .375 | 5.042 | .479 | .280 | .31 | 4.458 | 3½ | ⅜ | ¾ | 41.0 | 13.67 | 2.49 | 12.2 | 4.02 | 1.36 |
| 25.0 | 6.000 | 5 938 | .313 | 4 840 | 580 | .381 | .31 | 4 256 | 3½ | 15/32 | ¾ | 47.0 | 15 67 | 2.53 | 14.9 | 5.02 | 1.43 |
| 27 5 | 6.000 | 6 063 | .438 | 4 840 | 580 | 381 | 31 | 4 256 | 3½ | 15/32 | ¾ | 49.3 | 16.43 | 2.47 | 16.0 | 5.28 | 1.41 |
| **6" CARNEGIE SPECIAL BEAM SECTIONS** | | | | | | | | | | | | | | | | | |
| 40 0 | 5.750 | 9 500 | .489 | 4.772 | .489 | | .45 | 3 872 | 5½ | ½ | ⅞ | 69.6 | 24.21 | 2.43 | 69.9 | 14.72 | 2.44 |
| 50 0 | 5.986 | 9 617 | 606 | 4 772 | .607 | | .45 | 3 872 | 5½ | 19/32 | ⅞ | 91.0 | 30.40 | 2.49 | 90.1 | 18.74 | 2.48 |
| 60 0 | 6.216 | 9.733 | .722 | 4 772 | .722 | | 45 | 3 872 | 5½ | 23/32 | ⅞ | 113.9 | 36.65 | 2.54 | 111.1 | 22.83 | 2.51 |
| 70 0 | 6.444 | 9 846 | .835 | 4.772 | .836 | | .45 | 3 872 | 5½ | 27/32 | ⅞ | 138.7 | 43.05 | 2.60 | 133.3 | 27.08 | 2.54 |
| 80 0 | 6.666 | 9 959 | .948 | 4 772 | .947 | | 45 | 3 872 | 5½ | 15/16 | ⅞ | 164.9 | 49.47 | 2.65 | 156.3 | 31.39 | 2.58 |
| 88 0 | 6.842 | 10 046 | 1.035 | 4 772 | 1 035 | | 45 | 3 872 | 5½ | 11/32 | ⅞ | 187.3 | 54.75 | 2.69 | 175.4 | 34 92 | 2.60 |
| **8" CARNEGIE MILL SECTIONS** | | | | | | | | | | | | | | | | | |
| 17 5 | 8.000 | 4.981 | .231 | 7.108 | .446 | .238 | .25 | 6 608 | 2¾ | 5/16 | ¾ | 57.4 | 14.35 | 3.36 | 6.0 | 2.44 | 1.08 |
| 21.0 | 8 000 | 5 110 | .360 | 7.108 | .446 | 238 | .25 | 6 608 | 2¾ | 5/16 | ¾ | 63.4 | 15.85 | 3.21 | 6.6 | 2.58 | 1.03 |
| **8" CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | |
| 32 6 | 8 000 | 7.938 | .313 | 6.880 | .560 | .358 | 31 | 6 287 | 5½ | 15/32 | ⅞ | 112.8 | 28.20 | 3.45 | 34.2 | 8 62 | 1.90 |
| 34 3 | 8 000 | 8.000 | .375 | 6.880 | .560 | .358 | 31 | 6 287 | 5½ | 15/32 | ⅞ | 115.5 | 28.88 | 3.40 | 35.1 | 8.78 | 1.87 |
| 37 7 | 8 000 | 8 125 | 500 | 6.880 | .560 | .358 | 31 | 6 287 | 5½ | 15/32 | ⅞ | 120 8 | 30.20 | 3 31 | 36.9 | 9.08 | 1.83 |
| **9" CARNEGIE MILL SECTIONS** | | | | | | | | | | | | | | | | | |
| 20 5 | 9 000 | 5.234 | .234 | 8 008 | .496 | .277 | 28 | 7 458 | 2¾ | ⅜ | ¾ | 86.6 | 19.24 | 3.79 | 8.0 | 3.09 | 1.15 |
| 25 0 | 9 000 | 5.380 | 380 | 8 008 | 496 | .277 | 28 | 7 458 | 2¾ | ⅜ | ¾ | 95.5 | 21.22 | 3.61 | 8.8 | 3 27 | 1.09 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

4" to 9"

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 8″ AND 9″ ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 |
| **8″ AMERICAN STANDARD I BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 18 4 | 5 34 | 84 | 80 | 68 | 56 | 50 | 45 | 41 | 37 | 33 | | | | | | | | | | | | |
| 20 5 | 5 97 | 82 | 90 | 75 | 61 | 55 | 49 | 44 | 40 | 36 | | | | | | | | | | | | |
| **8″ CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | | | | | | |
| 32 6 | 9 50 | 1 90 | 143 | 143 | 143 | 143 | 140 | 135 | 130 | 124 | 119 | 114 | 109 | 104 | 100 | 95 | 91 | 83 | 75 | 68 | 62 | 57 |
| 34 3 | 10 00 | 1 87 | 150 | 150 | 150 | 150 | 146 | 141 | 136 | 130 | 124 | 119 | 114 | 108 | 103 | 99 | 94 | 85 | 78 | 71 | 64 | 59 |
| 37 7 | 11 00 | 1 83 | 165 | 165 | 165 | 165 | 160 | 154 | 147 | 141 | 135 | 129 | 123 | 117 | 112 | 106 | 101 | 92 | 83 | 76 | 69 | 63 |
| **8″ CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 24 0 | 7 06 | 1 61 | 106 | 106 | 106 | 102 | 97 | 93 | 88 | 84 | 79 | 75 | 71 | 67 | 64 | 60 | 57 | 51 | 46 | 41 | | |
| 27 0 | 7 93 | 1 62 | 119 | 119 | 119 | 114 | 109 | 104 | 99 | 94 | 89 | 85 | 80 | 76 | 72 | 68 | 64 | 58 | 52 | 47 | | |
| 30 0 | 8.81 | 1.63 | 132 | 132 | 132 | 127 | 122 | 116 | 111 | 105 | 100 | 95 | 90 | 85 | 80 | 76 | 72 | 65 | 58 | 52 | | |
| 31 0 | 9 10 | 2 01 | 137 | 137 | 137 | 137 | 137 | 132 | 127 | 123 | 118 | 113 | 109 | 104 | 100 | 96 | 91 | 84 | 77 | 70 | 64 | 59 |
| 36 0 | 10 58 | 2 02 | 159 | 159 | 159 | 159 | 159 | 154 | 149 | 143 | 138 | 132 | 127 | 122 | 116 | 112 | 107 | 98 | 89 | 82 | 75 | 69 |
| 42.0 | 12.34 | 2 04 | 185 | 185 | 185 | 185 | 185 | 180 | 174 | 168 | 161 | 155 | 149 | 143 | 137 | 131 | 126 | 115 | 105 | 97 | 89 | 81 |
| 48.0 | 14.10 | 2 06 | 212 | 212 | 212 | 212 | 212 | 207 | 200 | 192 | 185 | 178 | 171 | 164 | 158 | 151 | 145 | 133 | 122 | 112 | 102 | 94 |
| 54.0 | 15 87 | 2 07 | 238 | 238 | 238 | 238 | 238 | 233 | 225 | 217 | 209 | 201 | 193 | 186 | 178 | 171 | 164 | 150 | 138 | 126 | 116 | 107 |
| 60 0 | 17 63 | 2 09 | 264 | 264 | 264 | 264 | 264 | 260 | 251 | 242 | 234 | 225 | 216 | 208 | 199 | 191 | 183 | 168 | 154 | 142 | 130 | 120 |
| 66 0 | 19.40 | 2.11 | 291 | 291 | 291 | 291 | 291 | 287 | 277 | 268 | 258 | 249 | 239 | 230 | 221 | 212 | 203 | 187 | 172 | 158 | 145 | 133 |
| 72 0 | 21.17 | 2.12 | 318 | 318 | 318 | 318 | 318 | 314 | 303 | 293 | 282 | 272 | 262 | 252 | 242 | 232 | 223 | 205 | 188 | 173 | 159 | 146 |
| 78.0 | 22.93 | 2.14 | 344 | 344 | 344 | 344 | 344 | 341 | 330 | 319 | 307 | 296 | 285 | 274 | 264 | 253 | 243 | 224 | 206 | 189 | 174 | 160 |
| 84.0 | 24.71 | 2.15 | 371 | 371 | 371 | 371 | 371 | 368 | 356 | 344 | 332 | 320 | 308 | 296 | 285 | 274 | 263 | 242 | 223 | 205 | 189 | 174 |
| 90 0 | 26 47 | 2 17 | 397 | 397 | 397 | 397 | 397 | 395 | 383 | 370 | 357 | 345 | 332 | 320 | 307 | 295 | 284 | 261 | 241 | 222 | 204 | 188 |
| **9″ CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 29 0 | 8 53 | 1.59 | 128 | 128 | 128 | 122 | 117 | 111 | 105 | 100 | 95 | 90 | 85 | 80 | 76 | 72 | 68 | 61 | 54 | 49 | | |
| 32.0 | 9.40 | 1.60 | 141 | 141 | 141 | 135 | 129 | 123 | 117 | 111 | 105 | 99 | 94 | 89 | 84 | 80 | 75 | 67 | 60 | 54 | | |
| 35.0 | 10.29 | 1 61 | 154 | 154 | 154 | 148 | 142 | 135 | 128 | 122 | 115 | 109 | 103 | 98 | 93 | 88 | 83 | 74 | 67 | 60 | | |
| 38 0 | 11.17 | 2.26 | 168 | 168 | 168 | 168 | 168 | 168 | 164 | 159 | 154 | 149 | 144 | 138 | 133 | 128 | 124 | 114 | 106 | 95 | 90 | 83 |
| 43 0 | 12 65 | 2.28 | 190 | 190 | 190 | 190 | 190 | 190 | 186 | 181 | 175 | 169 | 163 | 157 | 152 | 146 | 141 | 130 | 120 | 111 | 103 | 95 |
| 48 0 | 14 11 | 2 29 | 212 | 212 | 212 | 212 | 212 | 212 | 208 | 202 | 196 | 189 | 183 | 176 | 170 | 164 | 158 | 146 | 135 | 125 | 116 | 107 |

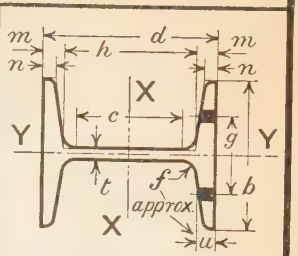
Loads to right of heavy vertical lines are for Secondary Members ONLY

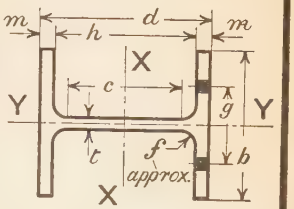
# DIMENSIONS AND FUNCTIONS OF 8″ AND 9″ ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | n | f | c | g | u | Riv. | I | S | r | I | S | r |
| **8″ AMERICAN STANDARD I BEAMS** | | | | | | | | | | | | | | | | | |
| 18.4 | 8 000 | 4 000 | .270 | 6 838 | .581 | .270 | .37 | 6.211 | 2¼ | 7/16 | ¾ | 56.9 | 14.22 | 3.26 | 3 8 | 1.90 | .84 |
| 20 5 | 8 000 | 4 080 | 349 | 6 838 | .581 | .270 | .37 | 6 211 | 2¼ | 7/16 | ¾ | 60 2 | 15 05 | 3.18 | 4 0 | 2 00 | .82 |
| **8″ CARNEGIE H BEAMS** | | | | | | | | | | | | | | | | | |
| 32.6 | 8 000 | 7 938 | .313 | 6 880 | .560 | .358 | .31 | 6.287 | 5½ | 15/32 | ⅞ | 112 8 | 28.20 | 3 45 | 34 2 | 8 62 | 1.90 |
| 34.3 | 8 000 | 8 000 | .375 | 6 880 | .560 | .358 | .31 | 6.287 | 5½ | 15/32 | ⅞ | 115 5 | 28 88 | 3 40 | 35.1 | 8.78 | 1.87 |
| 37 7 | 8 000 | 8.125 | 500 | 6 880 | 560 | 358 | .31 | 6.287 | 5½ | 15/32 | ⅞ | 120 8 | 30 20 | 3 31 | 36 9 | 9.08 | 1.83 |
| *** 8″ CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | | | |
| 24.0 | 8 000 | 6 500 | .239 | 7.200 | .400 | | .45 | 6.300 | 3½ | | ⅞ | 84 3 | 21 08 | 3 46 | 18.3 | 5 63 | 1 61 |
| 27.0 | 8 098 | 6 529 | .268 | 7.200 | .449 | | 45 | 6.300 | 3½ | | ⅞ | 95 9 | 23 68 | 3 48 | 20 8 | 6 37 | 1.62 |
| 30 0 | 8.196 | 6 559 | 298 | 7 200 | .498 | | .45 | 6.300 | 3½ | | ⅞ | 107 8 | 26 31 | 3.50 | 23 4 | 7.14 | 1.63 |
| 31.0 | 8 060 | 8 000 | 290 | 7 200 | .430 | | .45 | 6.300 | 5½ | | ⅞ | 110 9 | 27 52 | 3 49 | 36.7 | 9.18 | 2.01 |
| 36 0 | 8.198 | 8 046 | .336 | 7.200 | .499 | | .45 | 6.300 | 5½ | | ⅞ | 131 3 | 32.03 | 3.52 | 43.4 | 10.79 | 2.02 |
| 42.0 | 8 360 | 8.100 | .390 | 7 200 | .580 | | .45 | 6.300 | 5½ | | ⅞ | 156.2 | 37 37 | 3.56 | 51 4 | 12 69 | 2.04 |
| 48.0 | 8 520 | 8 155 | 445 | 7.200 | .660 | | .45 | 6.300 | 5½ | | ⅞ | 182.2 | 42.77 | 3.59 | 59 7 | 14.64 | 2.06 |
| 54.0 | 8 680 | 8 208 | .498 | 7.200 | .740 | | .45 | 6.300 | 5½ | | ⅞ | 209 2 | 48.20 | 3.63 | 68.3 | 16.64 | 2.07 |
| 60.0 | 8 838 | 8.261 | .551 | 7.200 | .819 | | .45 | 6.300 | 5½ | | ⅞ | 237.1 | 53 65 | 3.67 | 77.1 | 18 67 | 2.09 |
| 66.0 | 8 994 | 8.314 | .604 | 7.200 | .897 | | .45 | 6.300 | 5½ | | ⅞ | 265 9 | 59 13 | 3 70 | 86.1 | 20.71 | 2.11 |
| 72.0 | 9.150 | 8.366 | .656 | 7.200 | .975 | | .45 | 6.300 | 5½ | | ⅞ | 295 9 | 64 68 | 3.74 | 95.3 | 22.78 | 2.12 |
| 78.0 | 9.302 | 8 418 | .708 | 7.200 | 1.051 | | .45 | 6.300 | 5½ | | ⅞ | 326 5 | 70.20 | 3.77 | 104.7 | 24.88 | 2.14 |
| 84.0 | 9.456 | 8.469 | 759 | 7.200 | 1.128 | | .45 | 6.300 | 5½ | | ⅞ | 358 6 | 75.85 | 3.81 | 114.5 | 27.04 | 2.15 |
| 90.0 | 9.606 | 8 520 | 810 | 7.200 | 1.203 | | 45 | 6.300 | 5½ | | ⅞ | 391.2 | 81.45 | 3.84 | 124 4 | 29.20 | 2.17 |
| *** 9″ CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | | | |
| 29 0 | 9.000 | 6 500 | .279 | 8 060 | .470 | | .50 | 7 060 | 3½ | | ⅞ | 126 0 | 28 00 | 3.84 | 21.5 | 6.62 | 1.59 |
| 32 0 | 9.096 | 6 528 | .307 | 8 060 | .518 | | .50 | 7.060 | 3½ | | ⅞ | 140 5 | 30 89 | 3.87 | 24.0 | 7.35 | 1.60 |
| 35.0 | 9.192 | 6.556 | .335 | 8 060 | .566 | | .50 | 7.060 | 3½ | | ⅞ | 155.4 | 33 81 | 3.89 | 26.6 | 8.11 | 1.61 |
| 38.0 | 9.000 | 9.000 | .316 | 8 060 | .470 | | .50 | 7.060 | 5½ | | ⅞ | 170.4 | 37.87 | 3.91 | 57.1 | 12.69 | 2 26 |
| 43.0 | 9 122 | 9 041 | .357 | 8 060 | .531 | | .50 | 7 060 | 5½ | | ⅞ | 195.5 | 42.86 | 3.93 | 65.4 | 14.47 | 2.28 |
| 48 0 | 9 242 | 9 082 | .398 | 8 060 | 591 | | .50 | 7 060 | 5½ | | ⅞ | 221.1 | 47.85 | 3.96 | 73.8 | 16.25 | 2.29 |

*CARNEGIE BEAM SECTIONS have flanges of uniform thickness throughout their width.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

8″ & 9″

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 10″ ROLLED COLUMNS

CARNEGIE SECTIONS

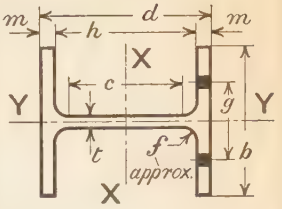
| Weight per foot | Area Sq In | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 10 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 |
| 10″ CARNEGIE BEAM SECTIONS | | | | | | | | | | | | | | | | | | | | | | |
| 21 | 6 17 | 1 39 | 88 | 79 | 70 | 65 | 61 | 57 | 54 | 51 | 47 | 45 | 42 | 37 | | | | | | | | |
| 23 | 6 76 | 1 43 | 97 | 87 | 78 | 73 | 69 | 65 | 61 | 57 | 54 | 50 | 47 | 42 | | | | | | | | |
| 26 | 7 64 | 1 43 | 110 | 99 | 88 | 83 | 78 | 73 | 69 | 65 | 61 | 57 | 54 | 48 | 42 | | | | | | | |
| 30 | 8 82 | 1 45 | 128 | 115 | 103 | 97 | 91 | 86 | 80 | 76 | 71 | 69 | 63 | 56 | 50 | | | | | | | |
| 31 | 9 11 | 1 89 | 137 | 134 | 124 | 119 | 114 | 109 | 104 | 100 | 95 | 91 | 86 | 79 | 72 | 65 | 60 | 54 | | | | |
| 36 | 10 58 | 1.80 | 159 | 153 | 140 | 134 | 128 | 122 | 117 | 111 | 106 | 101 | 96 | 87 | 79 | 71 | 65 | 59 | | | | |
| 42 | 12 35 | 1.73 | 185 | 175 | 161 | 153 | 146 | 139 | 132 | 125 | 119 | 113 | 107 | 97 | 88 | 79 | 72 | | | | | |
| 49 | 14.40 | 2 54 | 216 | 216 | 216 | 214 | 209 | 203 | 197 | 191 | 185 | 179 | 173 | 162 | 151 | 141 | 131 | 123 | 114 | 107 | 99 | 93 |
| 54 | 15.87 | 2 48 | 238 | 238 | 238 | 234 | 228 | 221 | 214 | 208 | 201 | 194 | 188 | 175 | 163 | 152 | 141 | 132 | 123 | 114 | 106 | 99 |
| 59 | 17 34 | 2 42 | 260 | 260 | 260 | 254 | 246 | 239 | 231 | 224 | 216 | 209 | 202 | 188 | 175 | 162 | 151 | 140 | 130 | 121 | 113 | 105 |
| 64 | 18.81 | 2 38 | 282 | 282 | 281 | 273 | 265 | 257 | 249 | 240 | 232 | 224 | 216 | 201 | 187 | 173 | 161 | 149 | 138 | 129 | 120 | 111 |
| 70 | 20 59 | 2 55 | 309 | 309 | 309 | 307 | 299 | 290 | 282 | 273 | 265 | 257 | 248 | 232 | 217 | 202 | 189 | 176 | 164 | 153 | 143 | 133 |
| 77 | 22 65 | 2.51 | 340 | 340 | 340 | 336 | 326 | 317 | 308 | 298 | 289 | 280 | 270 | 253 | 235 | 219 | 204 | 190 | 177 | 165 | 154 | 144 |
| 84 | 24 70 | 2 48 | 371 | 371 | 371 | 364 | 354 | 344 | 334 | 323 | 313 | 303 | 292 | 273 | 254 | 237 | 220 | 205 | 191 | 178 | 166 | 154 |
| 92 | 27 06 | 2 45 | 406 | 406 | 406 | 398 | 386 | 375 | 363 | 352 | 340 | 329 | 318 | 296 | 275 | 256 | 238 | 221 | 206 | 192 | 179 | 166 |
| 100 | 29.40 | 3.16 | 441 | 441 | 441 | 441 | 441 | 441 | 439 | 430 | 420 | 410 | 401 | 381 | 362 | 343 | 325 | 307 | 291 | 275 | 260 | 245 |
| 108 | 31 76 | 3 13 | 476 | 476 | 476 | 476 | 476 | 476 | 473 | 463 | 452 | 442 | 431 | 410 | 389 | 368 | 349 | 330 | 311 | 294 | 278 | 262 |
| 116 | 34 11 | 3 11 | 512 | 512 | 512 | 512 | 512 | 512 | 507 | 496 | 484 | 473 | 461 | 438 | 416 | 394 | 372 | 352 | 332 | 314 | 296 | 280 |
| 124 | 36 46 | 3 09 | 547 | 547 | 547 | 547 | 547 | 547 | 540 | 528 | 516 | 504 | 492 | 467 | 443 | 419 | 396 | 374 | 353 | 333 | 315 | 297 |
| 132 | 38 81 | 3 09 | 582 | 582 | 582 | 582 | 582 | 582 | 575 | 562 | 549 | 536 | 523 | 497 | 472 | 446 | 422 | 398 | 376 | 355 | 335 | 316 |
| 140 | 41 17 | 3 08 | 618 | 618 | 618 | 618 | 618 | 618 | 609 | 596 | 582 | 568 | 554 | 526 | 499 | 472 | 446 | 421 | 398 | 375 | 354 | 334 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

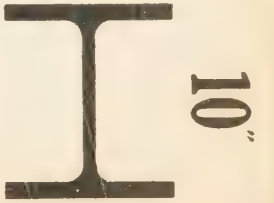
# DIMENSIONS AND FUNCTIONS OF 10″ ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | f | c | g | Riv. | I | S | r | I | S | r |
| 10″ CARNEGIE BEAM SECTIONS | | | | | | | | | | | | | | | |
| 21 | 9 902 | 6 000 | .230 | 9 238 | .332 | .30 | 8.638 | 3″ | ¾ | 107.6 | 21.7 | 4.18 | 12.0 | 4.0 | 1.39 |
| 23 | 10.000 | 6 000 | .230 | 9 238 | .381 | .30 | 8.638 | 3″ | ¾ | 122 2 | 24 4 | 4.25 | 13.7 | 4.6 | 1.43 |
| 26 | 10 098 | 6 029 | .259 | 9.238 | .430 | .30 | 8.638 | 3″ | ¾ | 139.5 | 27 6 | 4 27 | 15.7 | 5.2 | 1.43 |
| 30 | 10 228 | 6 068 | .298 | 9 238 | .495 | .30 | 8 638 | 3″ | ¾ | 163.2 | 31.9 | 4 30 | 18.5 | 6.1 | 1.45 |
| 31 | 10 000 | 8 000 | .320 | 9.238 | .381 | .30 | 8 638 | 5½ | ⅞ | 163.4 | 32.7 | 4.23 | 32.5 | 8.1 | 1.89 |
| 36 | 10 000 | 8 147 | .467 | 9.238 | .381 | .30 | 8 638 | 5½ | ⅞ | 175 6 | 35.1 | 4 07 | 34.4 | 8.5 | 1.80 |
| 42 | 10 000 | 8 324 | .644 | 9.238 | .381 | .30 | 8 638 | 5½ | ⅞ | 190.4 | 38.1 | 3.93 | 36.8 | 8.9 | 1.73 |
| 49 | 10 000 | 10 000 | .350 | 8.884 | .558 | .45 | 7 984 | 5½ | ⅞ | 272.0 | 54.4 | 4.35 | 93.0 | 18.6 | 2.54 |
| 54 | 10.000 | 10.147 | .497 | 8.884 | .558 | .45 | 7.984 | 5½ | ⅞ | 284.3 | 56.9 | 4.23 | 97.3 | 19.2 | 2.48 |
| 59 | 10.000 | 10 294 | .644 | 8.884 | .558 | .45 | 7.984 | 5½ | ⅞ | 296.5 | 59.3 | 4.13 | 101.7 | 19.8 | 2.42 |
| 64 | 10.000 | 10.441 | .791 | 8.884 | .558 | .45 | 7.984 | 5½ | ⅞ | 308.8 | 61.8 | 4.05 | 106.3 | 20.4 | 2.38 |
| 70 | 10 000 | 10 000 | 515 | 8 390 | .805 | .50 | 7.390 | 5½ | ⅞ | 369 3 | 73.9 | 4.24 | 134.3 | 26 9 | 2.55 |
| 77 | 10 000 | 10 206 | .721 | 8 390 | .805 | .50 | 7.390 | 5½ | ⅞ | 386 5 | 77.3 | 4.13 | 142 9 | 28 0 | 2.51 |
| 84 | 10 000 | 10 411 | .926 | 8 390 | .805 | .50 | 7.390 | 5½ | ⅞ | 403 6 | 80 7 | 4.04 | 152.0 | 29.2 | 2.48 |
| 92 | 10 000 | 10 647 | 1.162 | 8.390 | .805 | .50 | 7 396 | 5½ | ⅞ | 423 2 | 84.6 | 3 96 | 163.1 | 30.6 | 2.45 |
| 100 | 10 000 | 12 000 | .600 | 7.968 | 1.016 | .60 | 6.768 | 9″ | 1″ | 525.1 | 105.0 | 4.23 | 292.8 | 48.8 | 3.16 |
| 108 | 10 000 | 12.236 | .836 | 7.968 | 1.016 | .60 | 6.768 | 9″ | 1″ | 544 8 | 109.0 | 4.14 | 310 7 | 50.8 | 3.13 |
| 116 | 10 000 | 12 471 | 1.071 | 7.968 | 1.016 | .60 | 6.768 | 9″ | 1″ | 564.3 | 112.9 | 4.07 | 329.4 | 52.8 | 3.11 |
| 124 | 10 000 | 12 706 | 1.306 | 7.968 | 1.016 | .60 | 6 768 | 9″ | 1″ | 583 9 | 116 8 | 4.00 | 349.0 | 54.9 | 3.09 |
| 132 | 10 000 | 12.941 | 1.541 | 7.968 | 1.016 | .60 | 6 768 | 9″ | 1″ | 603.5 | 120 7 | 3.94 | 369.6 | 57.1 | 3 09 |
| 140 | 10 000 | 13 177 | 1.777 | 7 968 | 1 016 | .60 | 6 768 | 9″ | 1″ | 623 2 | 124.6 | 3 89 | 391.4 | 59.4 | 3 08 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration



# ALLOWABLE CONCENTRIC LOAD IN KIPS FOR 12″ ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 10 | 12 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| 12″ CARNEGIE BEAM SECTIONS | | | | | | | | | | | | | | | | | | | | | | |
| 25 | 7.34 | 1.37 | 104 | 93 | 82 | 72 | 67 | 63 | 59 | 55 | 52 | 49 | 43 | | | | | | | | | |
| 28 | 8.22 | 1.53 | 121 | 110 | 99 | 89 | 84 | 79 | 74 | 70 | 66 | 63 | 56 | 50 | | | | | | | | |
| 32 | 9.40 | 1.54 | 139 | 127 | 114 | 102 | 96 | 91 | 86 | 81 | 76 | 72 | 64 | 57 | | | | | | | | |
| † 34 | 9.99 | 1.45 | 145 | 130 | 116 | 103 | 97 | 91 | 86 | 81 | 76 | 71 | 63 | 56 | | | | | | | | |
| 36 | 10.59 | 1.55 | 157 | 143 | 129 | 115 | 109 | 103 | 97 | 92 | 87 | 82 | 73 | 65 | | | | | | | | |
| 40 | 11.76 | 1.95 | 176 | 175 | 163 | 150 | 144 | 138 | 132 | 125 | 121 | 115 | 105 | 96 | 88 | 80 | 73 | 67 | | | | |
| 45 | 13.23 | 1.97 | 198 | 197 | 184 | 170 | 163 | 156 | 149 | 143 | 137 | 131 | 119 | 109 | 99 | 91 | 83 | 77 | | | | |
| 50 | 14.69 | 1.98 | 220 | 220 | 204 | 189 | 181 | 174 | 166 | 159 | 152 | 146 | 133 | 122 | 111 | 102 | 93 | 86 | | | | |
| 55 | 16.17 | 2.24 | 243 | 243 | 237 | 222 | 214 | 207 | 199 | 192 | 185 | 178 | 164 | 152 | 140 | 129 | 120 | 111 | 102 | 95 | | |
| 60 | 17.65 | 2.25 | 265 | 265 | 259 | 243 | 234 | 226 | 218 | 210 | 202 | 195 | 180 | 166 | 154 | 142 | 131 | 121 | 112 | 104 | | |
| 66 | 19.41 | 2.26 | 291 | 291 | 285 | 267 | 258 | 249 | 241 | 232 | 223 | 215 | 199 | 184 | 170 | 157 | 145 | 134 | 124 | 115 | | |
| 65 | 19.11 | 3.03 | 287 | 287 | 287 | 287 | 287 | 281 | 275 | 268 | 262 | 255 | 242 | 229 | 216 | 204 | 193 | 182 | 171 | 162 | 152 | 144 |
| 70 | 20.58 | 2.96 | 309 | 309 | 309 | 309 | 307 | 300 | 293 | 286 | 279 | 271 | 257 | 243 | 229 | 216 | 203 | 191 | 180 | 170 | 160 | 151 |
| 76 | 22.35 | 2.90 | 335 | 335 | 335 | 335 | 331 | 324 | 316 | 308 | 299 | 291 | 275 | 260 | 245 | 230 | 217 | 204 | 192 | 180 | 169 | 160 |
| 82 | 24.11 | 3.09 | 362 | 362 | 362 | 362 | 362 | 357 | 349 | 341 | 333 | 325 | 309 | 293 | 277 | 262 | 247 | 234 | 220 | 208 | 196 | 185 |
| 88 | 25.88 | 3.04 | 388 | 388 | 388 | 388 | 388 | 381 | 373 | 364 | 355 | 346 | 328 | 311 | 294 | 278 | 262 | 247 | 233 | 220 | 207 | 195 |
| 95 | 27.93 | 2.99 | 419 | 419 | 419 | 419 | 418 | 409 | 399 | 390 | 380 | 370 | 351 | 332 | 313 | 295 | 278 | 262 | 247 | 233 | 219 | 207 |
| 102 | 29.99 | 2.95 | 450 | 450 | 450 | 450 | 447 | 437 | 427 | 416 | 405 | 395 | 374 | 353 | 333 | 314 | 295 | 278 | 262 | 246 | 232 | 218 |
| 110 | 32.34 | 3.10 | 485 | 485 | 485 | 485 | 485 | 480 | 469 | 458 | 448 | 437 | 415 | 393 | 373 | 352 | 333 | 314 | 297 | 280 | 264 | 250 |
| 120 | 35.28 | 3.06 | 529 | 529 | 529 | 529 | 529 | 521 | 509 | 497 | 485 | 473 | 449 | 426 | 403 | 380 | 359 | 339 | 319 | 301 | 284 | 268 |
| 130 | 38.24 | 3.03 | 574 | 574 | 574 | 574 | 574 | 563 | 550 | 537 | 524 | 510 | 484 | 458 | 433 | 409 | 386 | 364 | 343 | 323 | 305 | 287 |
| 140 | 41.18 | 3.01 | 618 | 618 | 618 | 618 | 618 | 605 | 591 | 576 | 562 | 548 | 519 | 491 | 464 | 438 | 413 | 389 | 367 | 346 | 326 | 307 |
| 150 | 44.12 | 3.69 | 662 | 662 | 662 | 662 | 662 | 662 | 662 | 662 | 655 | 643 | 618 | 593 | 568 | 544 | 519 | 496 | 473 | 451 | 430 | 409 |
| 160 | 47.06 | 3.67 | 706 | 706 | 706 | 706 | 706 | 706 | 706 | 706 | 698 | 684 | 658 | 631 | 604 | 578 | 552 | 527 | 502 | 479 | 456 | 434 |
| 170 | 50.00 | 3.65 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 740 | 726 | 697 | 669 | 640 | 612 | 584 | 557 | 531 | 506 | 482 | 459 |
| 180 | 52.94 | 3.64 | 794 | 794 | 794 | 794 | 794 | 794 | 794 | 794 | 782 | 768 | 737 | 707 | 677 | 647 | 617 | 589 | 561 | 535 | 509 | 485 |
| 190 | 55.88 | 3.71 | 838 | 838 | 838 | 838 | 838 | 838 | 838 | 838 | 831 | 816 | 785 | 754 | 722 | 691 | 660 | 631 | 602 | 574 | 547 | 521 |
| 200 | 58.82 | 3.71 | 882 | 882 | 882 | 882 | 882 | 882 | 882 | 882 | 875 | 859 | 826 | 793 | 760 | 727 | 695 | 664 | 633 | 604 | 576 | 549 |
| 210 | 61.76 | 3.72 | 926 | 926 | 926 | 926 | 926 | 926 | 926 | 926 | 920 | 903 | 869 | 834 | 799 | 765 | 731 | 698 | 666 | 636 | 606 | 578 |
| 220 | 64.70 | 3.73 | 971 | 971 | 971 | 971 | 971 | 971 | 971 | 971 | 964 | 947 | 911 | 875 | 839 | 803 | 767 | 733 | 700 | 667 | 636 | 607 |
| 230 | 67.64 | 3.74 | 1015 | 1015 | 1015 | 1015 | 1015 | 1015 | 1015 | 1015 | 1009 | 991 | 954 | 916 | 878 | 841 | 804 | 768 | 733 | 699 | 667 | 636 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

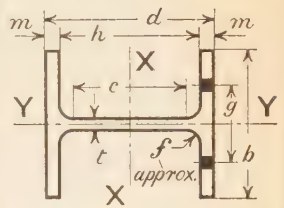
† Special Section. Web Thickness 3/8″.

# DIMENSIONS AND FUNCTIONS OF 12″ ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | AXIS X - X | | | AXIS Y - Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | f | c | g | Riv. | I | S | r | I | S | r |
| 12″ CARNEGIE BEAM SECTIONS | | | | | | | | | | | | | | | |
| 25 | 11.924 | 6.600 | .240 | 11.160 | 0.382 | .35 | 10.460 | 3″ | ¾ | 183.0 | 30.7 | 4.99 | 13.8 | 4.6 | 1.37 |
| 28 | 12.000 | 6 500 | .240 | 11.160 | .420 | .35 | 10 460 | 3″ | ¾ | 213.4 | 35.6 | 5 10 | 19 2 | 5.9 | 1.53 |
| 32 | 12.118 | 6 534 | .274 | 11.160 | .479 | .35 | 10 460 | 3″ | ¾ | 246.3 | 40.7 | 5.12 | 22.3 | 6.8 | 1.54 |
| †34 | 12.022 | 6.635 | .375 | 11.160 | .431 | .35 | 10 460 | 3″ | ¾ | 238 1 | 39.6 | 4.88 | 21 0 | 6.3 | 1.45 |
| 36 | 12.236 | 6.568 | .308 | 11.160 | .538 | .35 | 10.460 | 3″ | ¾ | 280.1 | 45.8 | 5.14 | 25.4 | 7.7 | 1.55 |
| 40 | 12.000 | 8.000 | .290 | 10.948 | .526 | .50 | 9.948 | 5½ | ⅞ | 313.7 | 52.3 | 5.17 | 44.9 | 11.2 | 1.95 |
| 45 | 12.130 | 8.036 | .326 | 10.948 | .591 | .50 | 9.948 | 5½ | ⅞ | 356.9 | 58.8 | 5.19 | 51.2 | 12.7 | 1.97 |
| 50 | 12.258 | 8.071 | .361 | 10.948 | .655 | .50 | 9.948 | 5½ | ⅞ | 400.5 | 65.4 | 5.22 | 57.5 | 14.2 | 1.98 |
| 55 | 12.000 | 9.000 | .375 | 10.670 | .665 | .55 | 9.570 | 5½ | ⅞ | 428.4 | 71.4 | 5.15 | 80.9 | 18.0 | 2.24 |
| 60 | 12.118 | 9.034 | .409 | 10.670 | .724 | .55 | 9.570 | 5½ | ⅞ | 472.0 | 77.9 | 5.17 | 89.0 | 19.7 | 2.25 |
| 66 | 12.260 | 9.073 | .448 | 10.670 | .795 | .55 | 9.570 | 5½ | ⅞ | 525.7 | 85 8 | 5.20 | 99.1 | 21 8 | 2.26 |
| 65 | 12.000 | 12 000 | .400 | 10.784 | .608 | .55 | 9.684 | 9″ | 1″ | 521.3 | 86.9 | 5.22 | 175.2 | 29.2 | 3.03 |
| 70 | 12.000 | 12 123 | .523 | 10.784 | .608 | .55 | 9.684 | 9″ | 1″ | 539.0 | 89.8 | 5.12 | 180.7 | 29.8 | 2.96 |
| 76 | 12.000 | 12 270 | .670 | 10.784 | .608 | .55 | 9.684 | 9″ | 1″ | 560.2 | 93.4 | 5.01 | 187.5 | 30.6 | 2.90 |
| 82 | 12.000 | 12 000 | .453 | 10.400 | .800 | .55 | 9.300 | 9″ | 1″ | 650.8 | 108.5 | 5.20 | 230.5 | 38.4 | 3.09 |
| 88 | 12.000 | 12 147 | .600 | 10.400 | .800 | .55 | 9.300 | 9″ | 1″ | 672.0 | 112.0 | 5.10 | 239.2 | 39.4 | 3.04 |
| 95 | 12 000 | 12.318 | .771 | 10.400 | .800 | .55 | 9.300 | 9″ | 1″ | 696.6 | 116.1 | 4.99 | 249.7 | 40.5 | 2.99 |
| 102 | 12 000 | 12 490 | .943 | 10.400 | .800 | .55 | 9.300 | 9″ | 1″ | 721.4 | 120.2 | 4.90 | 260.6 | 41.7 | 2.95 |
| 110 | 12.000 | 12.000 | .640 | 9.850 | 1.075 | .60 | 8.650 | 9″ | 1″ | 828.8 | 138.1 | 5.06 | 309.9 | 51.6 | 3.10 |
| 120 | 12.000 | 12 245 | .885 | 9.850 | 1.075 | .60 | 8.650 | 9″ | 1″ | 864.1 | 144.0 | 4.95 | 329.6 | 53.8 | 3.06 |
| 130 | 12.000 | 12.491 | 1.131 | 9.850 | 1.075 | .60 | 8.650 | 9″ | 1″ | 899.5 | 149.9 | 4.85 | 350.5 | 56.1 | 3.03 |
| 140 | 12.000 | 12 736 | 1.376 | 9.850 | 1.075 | .60 | 8.650 | 9″ | 1″ | 934.8 | 155.8 | 4.76 | 372.4 | 58.5 | 3.01 |
| 150 | 12.000 | 14 000 | .757 | 9.376 | 1.312 | .65 | 8.076 | 10″ | 1″ | 1112.2 | 185.4 | 5.02 | 600.4 | 85.8 | 3.69 |
| 160 | 12.000 | 14.245 | 1.002 | 9 376 | 1.312 | .65 | 8.076 | 10″ | 1″ | 1147.5 | 191.3 | 4.94 | 633.0 | 88.9 | 3.67 |
| 170 | 12.000 | 14.490 | 1.247 | 9.376 | 1.312 | .65 | 8.076 | 10″ | 1″ | 1182.8 | 197.1 | 4.86 | 666.9 | 92.1 | 3.65 |
| 180 | 12 000 | 14.735 | 1.492 | 9.376 | 1.312 | .65 | 8.076 | 10″ | 1″ | 1218.1 | 203.0 | 4.80 | 702 4 | 95.3 | 3.64 |
| 190 | 12.000 | 14.000 | 1 000 | 8.646 | 1.677 | .65 | 7.346 | 10″ | 1″ | 1320.8 | 220.1 | 4.86 | 767.8 | 109.7 | 3.71 |
| 200 | 12.000 | 14.245 | 1.245 | 8.646 | 1.677 | .65 | 7.346 | 10″ | 1″ | 1356.1 | 226.0 | 4.80 | 809.5 | 113.7 | 3.71 |
| 210 | 12 000 | 14 490 | 1.490 | 8.646 | 1.677 | .65 | 7.346 | 10″ | 1″ | 1391.3 | 231.9 | 4.75 | 852.9 | 117.7 | 3.72 |
| 220 | 12 000 | 14.735 | 1.735 | 8 646 | 1.677 | .65 | 7.346 | 10″ | 1″ | 1426.6 | 237.8 | 4.70 | 898.2 | 121.9 | 3.73 |
| 230 | 12.000 | 14.980 | 1.980 | 8.646 | 1.677 | .65 | 7.346 | 10″ | 1″ | 1461.9 | 243.7 | 4.65 | 945.5 | 126.2 | 3.74 |

† Special Section. Web Thickness ⅜″




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

12″

# ALLOWABLE CONCENTRIC LOAD IN KIPS FOR 14" ROLLED COLUMNS CARNEGIE SECTIONS

| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 10 | 12 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| **14" CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | | | | | | | | |
| 30 | 8.82 | 1.33 | 123 | 109 | 96 | 84 | 79 | 74 | 69 | 64 | 60 | 57 | 50 | | | | | | | | | |
| 33 | 9.71 | 1.54 | 144 | 131 | 118 | 105 | 99 | 94 | 88 | 84 | 79 | 74 | 66 | 59 | | | | | | | | |
| 36 | 10.58 | 1.55 | 157 | 143 | 129 | 115 | 109 | 103 | 97 | 92 | 86 | 82 | 73 | 65 | | | | | | | | |
| † 38 | 11.18 | 1.47 | 163 | 147 | 131 | 117 | 110 | 103 | 97 | 91 | 86 | 81 | 72 | 64 | | | | | | | | |
| 39 | 11.47 | 1.56 | 171 | 155 | 140 | 126 | 119 | 112 | 106 | 100 | 94 | 89 | 80 | 71 | 64 | | | | | | | |
| 42 | 12.35 | 1.56 | 184 | 167 | 151 | 135 | 128 | 121 | 114 | 108 | 102 | 96 | 86 | 77 | 69 | | | | | | | |
| 48 | 14.12 | 1.90 | 212 | 208 | 193 | 177 | 170 | 162 | 155 | 148 | 141 | 135 | 123 | 112 | 102 | 93 | 85 | | | | | |
| 53 | 15.59 | 1.91 | 234 | 230 | 213 | 196 | 188 | 180 | 172 | 164 | 157 | 149 | 136 | 124 | 113 | 103 | 94 | | | | | |
| 58 | 17.05 | 1.92 | 256 | 252 | 234 | 215 | 206 | 197 | 189 | 180 | 172 | 164 | 150 | 136 | 124 | 114 | 104 | 95 | | | | |
| 61 | 17.94 | 2.44 | 269 | 269 | 269 | 256 | 248 | 240 | 233 | 225 | 217 | 210 | 196 | 182 | 169 | 157 | 146 | 136 | 126 | | | |
| 68 | 19.99 | 2.46 | 300 | 300 | 300 | 286 | 277 | 269 | 260 | 252 | 244 | 235 | 219 | 204 | 190 | 177 | 164 | 153 | 142 | | | |
| 75 | 22.05 | 2.47 | 331 | 331 | 331 | 316 | 306 | 297 | 288 | 279 | 269 | 260 | 243 | 226 | 210 | 196 | 182 | 169 | 158 | | | |
| 85 | 24.99 | 3.05 | 375 | 375 | 375 | 375 | 375 | 369 | 360 | 352 | 343 | 335 | 318 | 301 | 284 | 269 | 254 | 239 | 226 | | | |
| 95 | 27.93 | 3.06 | 419 | 419 | 419 | 419 | 419 | 413 | 403 | 394 | 384 | 375 | 356 | 337 | 319 | 301 | 284 | 268 | 253 | | | |
| 105 | 30.88 | 3.08 | 463 | 463 | 463 | 463 | 463 | 457 | 447 | 437 | 426 | 416 | 395 | 374 | 354 | 335 | 316 | 298 | 281 | | | |
| 86 | 25.28 | 3.84 | 379 | 379 | 379 | 379 | 379 | 379 | 379 | 379 | 379 | 374 | 360 | 347 | 333 | 319 | 306 | 293 | 280 | 267 | 255 | 244 |
| 96 | 28.23 | 3.86 | 423 | 423 | 423 | 423 | 423 | 423 | 423 | 423 | 423 | 418 | 403 | 388 | 373 | 358 | 343 | 328 | 314 | 300 | 286 | 273 |
| 106 | 31.18 | 3.87 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 462 | 446 | 429 | 412 | 396 | 379 | 363 | 347 | 332 | 317 | 303 |
| 115 | 33.82 | 3.89 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 502 | 485 | 467 | 448 | 430 | 413 | 395 | 378 | 361 | 345 | 330 |
| 125 | 36.75 | 3.90 | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 547 | 527 | 508 | 488 | 468 | 449 | 430 | 411 | 393 | 376 | 359 |
| ‡ 131 | 38.52 | 3.77 | 578 | 578 | 578 | 578 | 578 | 578 | 578 | 578 | 576 | 566 | 545 | 524 | 502 | 481 | 460 | 440 | 420 | 401 | 382 | 365 |
| 135 | 39.70 | 3.92 | 596 | 596 | 596 | 596 | 596 | 596 | 596 | 596 | 596 | 591 | 570 | 549 | 528 | 507 | 486 | 466 | 446 | 426 | 407 | 389 |
| 145 | 42.64 | 3.93 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 636 | 614 | 591 | 568 | 546 | 523 | 502 | 480 | 459 | 439 | 420 |
| 155 | 45.58 | 3.94 | 684 | 684 | 684 | 684 | 684 | 684 | 684 | 684 | 684 | 680 | 657 | 633 | 608 | 584 | 560 | 537 | 514 | 492 | 470 | 450 |
| 165 | 48.52 | 3.96 | 728 | 728 | 728 | 728 | 728 | 728 | 728 | 728 | 728 | 725 | 700 | 675 | 649 | 624 | 599 | 574 | 549 | 526 | 503 | 481 |
| 175 | 51.47 | 3.97 | 772 | 772 | 772 | 772 | 772 | 772 | 772 | 772 | 772 | 770 | 744 | 717 | 690 | 663 | 636 | 610 | 584 | 559 | 535 | 511 |
| 185 | 54.41 | 3.98 | 816 | 816 | 816 | 816 | 816 | 816 | 816 | 816 | 816 | 815 | 787 | 759 | 731 | 702 | 674 | 646 | 619 | 593 | 567 | 542 |
| 195 | 57.34 | 4.00 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 831 | 801 | 771 | 741 | 712 | 683 | 654 | 626 | 599 | 573 |
| 205 | 60.28 | 4.01 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 874 | 843 | 812 | 781 | 749 | 719 | 689 | 660 | 631 | 604 |
| 215 | 63.23 | 4.03 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 919 | 886 | 853 | 821 | 788 | 756 | 725 | 694 | 664 | 636 |
| 225 | 66.17 | 4.04 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 963 | 929 | 895 | 860 | 826 | 793 | 760 | 728 | 697 | 668 |
| 235 | 69.11 | 4.05 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1006 | 971 | 936 | 900 | 864 | 830 | 795 | 762 | 730 | 699 |
| 245 | 72.06 | 4.06 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1051 | 1014 | 977 | 940 | 903 | 867 | 832 | 797 | 763 | 731 |
| 255 | 74.99 | 4.08 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1095 | 1057 | 1019 | 980 | 942 | 905 | 868 | 832 | 797 | 763 |
| 265 | 77.93 | 4.09 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1139 | 1100 | 1060 | 1020 | 981 | 942 | 903 | 866 | 830 | 795 |

NOTE: For the convenience of the designer beams from 68 lb. to 265 lb. per foot are duplicated on the following page in conjunction with those from 275 lb. to 425 lb. per foot.
Loads to right of heavy vertical lines are for Secondary Members ONLY. † Special Section: Web Thickness 3/8". ‡ Special Section for Column Core.

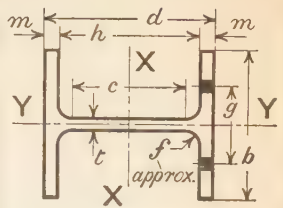
# DIMENSIONS AND FUNCTIONS OF 14" ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | AXIS X - X | | | AXIS Y - Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | f | c | g | Riv. | I | S | r | I | S | r |
| **14" CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | |
| 30 | 13.964 | 6 000 | .270 | 13.102 | .431 | .40 | 12 302 | 3" | ¾ | 292.0 | 41.8 | 5.75 | 15.5 | 5.2 | 1.33 |
| 33 | 14 000 | 6 750 | 270 | 13.102 | 449 | 40 | 12.302 | 3" | ¾ | 333.4 | 47.6 | 5.86 | 23.0 | 6.8 | 1.54 |
| 36 | 14.080 | 6 774 | .294 | 13.102 | 489 | .40 | 12 302 | 3" | ¾ | 365.6 | 51.9 | 5.88 | 25.4 | 7.5 | 1.55 |
| †38 | 14.000 | 6.855 | .375 | 13.102 | .449 | .40 | 12 302 | 3" | ¾ | 357.5 | 51.1 | 5.66 | 24.2 | 7.1 | 1.47 |
| 39 | 14.160 | 6.798 | .318 | 13.102 | .529 | .40 | 12 302 | 3" | ¾ | 398.3 | 56.3 | 5 89 | 27.7 | 8.2 | 1.56 |
| 42 | 14.240 | 6 822 | .342 | 13.102 | .569 | .40 | 12.302 | 3" | ¾ | 431.5 | 60 6 | 5 91 | 30.2 | 8.8 | 1.56 |
| 48 | 14.000 | 8.000 | .343 | 12.810 | .595 | .55 | 11.710 | 5½ | ⅞ | 496.0 | 70 9 | 5.93 | 50.8 | 12.7 | 1.90 |
| 53 | 14.122 | 8 035 | .378 | 12.810 | .656 | .55 | 11 719 | 5½ | ⅞ | 552.5 | 78.2 | 5.95 | 56.8 | 14.1 | 1.91 |
| 58 | 14.242 | 8 070 | .413 | 12 810 | .716 | 55 | 11.710 | 5½ | ⅞ | 609.4 | 85.6 | 5.98 | 62.8 | 15.6 | 1.92 |
| 61 | 14.094 | 10.000 | .382 | 12.810 | .642 | .55 | 11.710 | 5½ | 1" | 656.2 | 93.1 | 6.05 | 107.1 | 21.4 | 2.44 |
| 68 | 14.238 | 10 043 | .425 | 12.810 | .714 | .55 | 11.710 | 5½ | 1" | 738:8 | 103.8 | 6.08 | 120.6 | 24.0 | 2.46 |
| 75 | 14.382 | 10 086 | .468 | 12.810 | .786 | .55 | 11.710 | 5½ | 1" | 823.5 | 114 5 | 6.11 | 134.5 | 26.7 | 2.47 |
| 85 | 14.000 | 12.000 | .435 | 12.390 | .805 | .65 | 11.090 | 9" | 1" | 921.3 | 131 6 | 6.07 | 232 0 | 38.7 | 3.05 |
| 95 | 14.186 | 12.050 | .485 | 12.390 | .898 | .65 | 11 099 | 9" | 1" | 1044.0 | 147.2 | 6.11 | 262.0 | 43.5 | 3.06 |
| 105 | 14.370 | 12.101 | .536 | 12.390 | .990 | .65 | 11.090 | 9" | 1" | 1169.6 | 162.8 | 6.15 | 292.6 | 48.4 | 3.08 |
| 86 | 13.714 | 15.008 | .414 | 12.390 | .662 | .65 | 11.090 | 10" | 1" | 923.0 | 136.6 | 6.04 | 373.1 | 49.7 | 3.84 |
| 96 | 13.866 | 15.056 | .462 | 12.390 | .738 | .65 | 11.090 | 10" | 1" | 1042.1 | 150.3 | 6.08 | 419.9 | 55.8 | 3.86 |
| 106 | 14.018 | 15.103 | .509 | 12.390 | .814 | .65 | 11.090 | 10" | 1" | 1164.1 | 166.1 | 6.11 | 467.6 | 61.9 | 3.87 |
| 115 | 14.154 | 15.145 | .551 | 12.390 | .882 | .65 | 11 090 | 10" | 1" | 1275 9 | 180 3 | 6.14 | 510.9 | 67.5 | 3.89 |
| 125 | 14.304 | 15.191 | .597 | 12.390 | .957 | .65 | 11.090 | 10" | 1" | 1402.1 | 196 0 | 6.18 | 559.4 | 73.7 | 3.90 |
| ‡131 | 14.162 | 15 468 | .874 | 12.390 | .886 | .65 | 11.090 | 10" | 1" | 1358.4 | 191.8 | 5.94 | 547.3 | 70.8 | 3.77 |
| 135 | 14.452 | 15 239 | .645 | 12.390 | 1.031 | .65 | 11.090 | 10" | 1" | 1530.4 | 211.8 | 6.21 | 608 4 | 79 9 | 3.92 |
| 145 | 14.602 | 15 284 | .690 | 12.390 | 1.106 | .65 | 11 090 | 10" | 1" | 1662.7 | 227.7 | 6.24 | 658.5 | 86 2 | 3.93 |
| 155 | 14.750 | 15 330 | .736 | 12.390 | 1.180 | .65 | 11 090 | 10" | 1" | 1796.8 | 243 6 | 6.28 | 709 0 | 92 5 | 3.94 |
| 165 | 14.896 | 15 377 | .783 | 12.390 | 1.253 | .65 | 11.090 | 10" | 1" | 1932.6 | 259.5 | 6.31 | 759.9 | 98.8 | 3.96 |
| 175 | 15.042 | 15.424 | .830 | 12.390 | 1.326 | .65 | 11.090 | 10" | 1" | 2071.7 | 275.5 | 6.34 | 811.6 | 105.2 | 3 97 |
| 185 | 15.188 | 15 469 | .875 | 12.390 | 1.399 | .65 | 11.090 | 10" | 1" | 2213.5 | 291.5 | 6.38 | 863 9 | 111.7 | 3.98 |
| 195 | 15.334 | 15 513 | .919 | 12.390 | 1.472 | .65 | 11 090 | 10" | 1" | 2358.2 | 307.6 | 6.41 | 916 8 | 118.2 | 4.00 |
| 205 | 15.478 | 15 559 | .965 | 12.390 | 1 544 | .65 | 11 096 | 10" | 1" | 2505 0 | 323.7 | 6.45 | 970.3 | 124.7 | 4 01 |
| 215 | 15.622 | 15 604 | 1.010 | 12.390 | 1 616 | .65 | 11.090 | 10" | 1" | 2654.7 | 339.9 | 6.48 | 1024.5 | 131.3 | 4.03 |
| 225 | 15.764 | 15.650 | 1.056 | 12.390 | 1.687 | .65 | 11 090 | 10" | 1" | 2806.2 | 356 0 | 6.51 | 1079.1 | 137.9 | 4.04 |
| 235 | 15 908 | 15 693 | 1 099 | 12 390 | 1.759 | .65 | 11 090 | 10" | 1" | 2961.9 | 372 4 | 6.55 | 1134.5 | 144.6 | 4.05 |
| 245 | 16.050 | 15.738 | 1.144 | 12.390 | 1.830 | .65 | 11.090 | 10" | 1" | 3119.6 | 388.7 | 6.58 | 1190.6 | 151.3 | 4.06 |
| 255 | 16.192 | 15.781 | 1.187 | 12.390 | 1.901 | .65 | 11 090 | 10" | 1" | 3280.0 | 405.1 | 6.61 | 1247.1 | 158.0 | 4.08 |
| 265 | 16.332 | 15 826 | 1.232 | 12.390 | 1 971 | .65 | 11.090 | 10" | 1" | 3442.4 | 421.6 | 6.65 | 1304.2 | 164.8 | 4.09 |

NOTE: For the convenience of the designer beams from 68 lb. to 265 lb. per foot are duplicated on the following page in conjunction with those from 275 lb. to 425 lb. per foot.

† Special Section Web Thickness ⅜"
‡ Special Section for Column core




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

14"

# ALLOWABLE CONCENTRIC LOAD IN KIPS FOR 14" ROLLED COLUMNS CARNEGIE SECTIONS

| Weight per foot | Area Sq. In. | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 10 | 12 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| 14" CARNEGIE BEAM SECTIONS | | | | | | | | | | | | | | | | | | | | | | |
| 68 | 19.99 | 2.46 | 300 | 300 | 300 | 286 | 277 | 269 | 260 | 252 | 244 | 235 | 219 | 204 | 190 | 177 | 164 | 153 | 142 | | | |
| 75 | 22.05 | 2 47 | 331 | 331 | 331 | 316 | 306 | 297 | 288 | 279 | 269 | 260 | 243 | 226 | 210 | 196 | 182 | 169 | 158 | | | |
| 85 | 24.99 | 3.05 | 375 | 375 | 375 | 375 | 375 | 369 | 360 | 352 | 343 | 335 | 318 | 301 | 284 | 269 | 254 | 239 | 226 | | | |
| 95 | 27.93 | 3 06 | 419 | 419 | 419 | 419 | 419 | 413 | 403 | 394 | 384 | 375 | 356 | 337 | 319 | 301 | 284 | 268 | 253 | | | |
| 105 | 30.88 | 3.08 | 463 | 463 | 463 | 463 | 463 | 457 | 447 | 437 | 426 | 416 | 395 | 374 | 354 | 335 | 316 | 298 | 281 | | | |
| 86 | 25.28 | 3.84 | 379 | 379 | 379 | 379 | 379 | 379 | 379 | 379 | 379 | 374 | 360 | 347 | 333 | 319 | 306 | 293 | 280 | 267 | 255 | 244 |
| 96 | 28.23 | 3 86 | 423 | 423 | 423 | 423 | 423 | 423 | 423 | 423 | 423 | 418 | 403 | 388 | 373 | 358 | 343 | 328 | 314 | 300 | 286 | 273 |
| 106 | 31.18 | 3.87 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 468 | 462 | 446 | 429 | 412 | 396 | 379 | 363 | 347 | 332 | 317 | 303 |
| 115 | 33.82 | 3 89 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 502 | 485 | 467 | 448 | 430 | 413 | 395 | 378 | 361 | 345 | 330 |
| 125 | 36.75 | 3.90 | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 547 | 527 | 508 | 488 | 468 | 449 | 430 | 411 | 393 | 376 | 359 |
| ‡ 131 | 38.52 | 3 77 | 578 | 578 | 578 | 578 | 578 | 578 | 578 | 578 | 576 | 566 | 545 | 524 | 502 | 481 | 460 | 440 | 420 | 401 | 382 | 365 |
| 135 | 39.70 | 3.92 | 596 | 596 | 596 | 596 | 596 | 596 | 596 | 596 | 596 | 591 | 570 | 549 | 528 | 507 | 486 | 466 | 446 | 426 | 407 | 389 |
| 145 | 42.64 | 3.93 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 640 | 636 | 614 | 591 | 568 | 546 | 523 | 502 | 480 | 459 | 439 | 420 |
| 155 | 45.58 | 3.94 | 684 | 684 | 684 | 684 | 684 | 684 | 684 | 684 | 684 | 680 | 657 | 633 | 608 | 584 | 560 | 537 | 514 | 492 | 470 | 450 |
| 165 | 48.52 | 3.96 | 728 | 728 | 728 | 728 | 728 | 728 | 728 | 728 | 728 | 725 | 700 | 675 | 649 | 624 | 599 | 574 | 549 | 526 | 503 | 481 |
| 175 | 51.47 | 3 97 | 772 | 772 | 772 | 772 | 772 | 772 | 772 | 772 | 772 | 770 | 744 | 717 | 690 | 663 | 636 | 610 | 584 | 559 | 535 | 511 |
| 185 | 54.41 | 3.98 | 816 | 816 | 816 | 816 | 816 | 816 | 816 | 816 | 816 | 815 | 787 | 759 | 731 | 702 | 674 | 646 | 619 | 593 | 567 | 542 |
| 195 | 57.34 | 4 00 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 860 | 831 | 801 | 771 | 741 | 712 | 683 | 654 | 626 | 599 | 573 |
| 205 | 60.28 | 4 01 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 904 | 874 | 843 | 812 | 781 | 749 | 719 | 689 | 660 | 631 | 604 |
| 215 | 63.23 | 4.03 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 949 | 919 | 886 | 853 | 821 | 788 | 756 | 725 | 694 | 664 | 636 |
| 225 | 66.17 | 4.04 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 993 | 963 | 929 | 895 | 860 | 826 | 793 | 760 | 728 | 697 | 668 |
| 235 | 69.11 | 4.05 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1037 | 1006 | 971 | 936 | 900 | 864 | 830 | 795 | 762 | 730 | 699 |
| 245 | 72.06 | 4.06 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1081 | 1051 | 1014 | 977 | 940 | 903 | 867 | 832 | 797 | 763 | 731 |
| 255 | 74.99 | 4.08 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1125 | 1095 | 1057 | 1019 | 980 | 942 | 905 | 868 | 832 | 797 | 763 |
| 265 | 77.93 | 4.09 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1169 | 1139 | 1100 | 1060 | 1020 | 981 | 942 | 903 | 866 | 830 | 795 |
| 275 | 80.87 | 4.10 | 1213 | 1213 | 1213 | 1213 | 1213 | 1213 | 1213 | 1213 | 1213 | 1213 | 1183 | 1143 | 1101 | 1060 | 1019 | 979 | 939 | 900 | 863 | 826 |
| 285 | 83.82 | 4.12 | 1257 | 1257 | 1257 | 1257 | 1257 | 1257 | 1257 | 1257 | 1257 | 1257 | 1229 | 1187 | 1144 | 1102 | 1059 | 1018 | 977 | 937 | 898 | 860 |
| 295 | 86.76 | 4.13 | 1301 | 1301 | 1301 | 1301 | 1301 | 1301 | 1301 | 1301 | 1301 | 1301 | 1273 | 1229 | 1186 | 1142 | 1098 | 1055 | 1013 | 971 | 931 | 892 |
| 305 | 89.70 | 4.14 | 1346 | 1346 | 1346 | 1346 | 1346 | 1346 | 1346 | 1346 | 1346 | 1346 | 1317 | 1272 | 1227 | 1182 | 1137 | 1092 | 1049 | 1006 | 965 | 924 |
| 325 | 95.58 | 4.17 | 1434 | 1434 | 1434 | 1434 | 1434 | 1434 | 1434 | 1434 | 1434 | 1434 | 1407 | 1360 | 1312 | 1264 | 1217 | 1170 | 1123 | 1078 | 1034 | 991 |
| 345 | 101.47 | 4.19 | 1522 | 1522 | 1522 | 1522 | 1522 | 1522 | 1522 | 1522 | 1522 | 1522 | 1496 | 1447 | 1396 | 1346 | 1295 | 1245 | 1196 | 1148 | 1102 | 1056 |
| 365 | 107.34 | 4.22 | 1610 | 1610 | 1610 | 1610 | 1610 | 1610 | 1610 | 1610 | 1610 | 1610 | 1587 | 1535 | 1482 | 1429 | 1376 | 1323 | 1272 | 1221 | 1172 | 1124 |
| 385 | 113.22 | 4.24 | 1698 | 1698 | 1698 | 1698 | 1698 | 1698 | 1698 | 1698 | 1698 | 1698 | 1677 | 1622 | 1567 | 1511 | 1455 | 1400 | 1346 | 1293 | 1241 | 1190 |
| 405 | 119.12 | 4.27 | 1787 | 1787 | 1787 | 1787 | 1787 | 1787 | 1787 | 1787 | 1787 | 1787 | 1769 | 1712 | 1654 | 1595 | 1537 | 1479 | 1423 | 1367 | 1313 | 1260 |
| 425 | 124.99 | 4.29 | 1875 | 1875 | 1875 | 1875 | 1875 | 1875 | 1875 | 1875 | 1875 | 1875 | 1859 | 1799 | 1739 | 1678 | 1617 | 1557 | 1497 | 1439 | 1382 | 1327 |

NOTE: For the convenience of the designer beams from 68 lb. to 265 lb. per foot are duplicated on the preceding page in conjunction with those from 30 lb. to 61 lb. per foot.
Loads to right of heavy vertical lines are for Secordary Members ONLY. ‡ Special Section for Column Core.

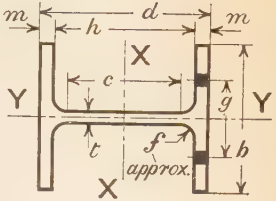
# DIMENSIONS AND FUNCTIONS OF 14″ ROLLED COLUMNS

CARNEGIE SECTIONS

| Weight per foot | DIMENSIONS | | | | | | | | | AXIS X-X | | | AXIS Y-Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d | b | t | h | m | f | c | g | Riv. | I | S | r | I | S | r |
| **14″ CARNEGIE BEAM SECTIONS** | | | | | | | | | | | | | | | |
| 68 | 14.238 | 10.043 | .425 | 12 810 | .714 | .55 | 11.710 | 5½ | 1″ | 738 8 | 103.8 | 6 08 | 120.6 | 24.0 | 2.46 |
| 75 | 14.382 | 10.086 | .468 | 12 810 | .786 | .55 | 11.710 | 5½ | 1″ | 823 5 | 114.5 | 6.11 | 134.5 | 26.7 | 2.47 |
| 85 | 14.000 | 12.000 | .435 | 12.390 | .805 | .65 | 11.090 | 9″ | 1″ | 921.3 | 131.6 | 6.07 | 232 0 | 38.7 | 3.05 |
| 95 | 14.186 | 12.050 | .485 | 12.390 | .898 | .65 | 11.090 | 9″ | 1″ | 1044 0 | 147.2 | 6 11 | 262 0 | 43.5 | 3.06 |
| 105 | 14.370 | 12.101 | .536 | 12.390 | .990 | .65 | 11.090 | 9″ | 1″ | 1169.6 | 162.8 | 6.15 | 292 6 | 48.4 | 3.08 |
| 86 | 13.714 | 15.008 | .414 | 12.390 | .662 | .65 | 11.090 | 10″ | 1″ | 923.0 | 136.6 | 6.04 | 373.1 | 49.7 | 3.84 |
| 96 | 13.866 | 15.056 | .462 | 12.390 | .738 | .65 | 11.090 | 10″ | 1″ | 1042.1 | 150.3 | 6.08 | 419.9 | 55.8 | 3.86 |
| 106 | 14.018 | 15.103 | .509 | 12.390 | .814 | .65 | 11.090 | 10″ | 1″ | 1164.1 | 166.1 | 6.11 | 467.6 | 61.9 | 3.87 |
| 115 | 14.154 | 15.145 | .551 | 12 390 | .882 | .65 | 11.090 | 10″ | 1″ | 1275 9 | 180.3 | 6 14 | 510.9 | 67.5 | 3 89 |
| 125 | 14.304 | 15.191 | .597 | 12.390 | .957 | 65 | 11 090 | 10″ | 1″ | 1402.1 | 196 0 | 6.18 | 559 4 | 73 7 | 3.90 |
| ‡131 | 14.162 | 15.468 | .874 | 12.390 | .886 | .65 | 11.090 | 10″ | 1″ | 1358 4 | 191 8 | 5.94 | 547.3 | 70 8 | 3 77 |
| 135 | 14.452 | 15.239 | .645 | 12.390 | 1.931 | .65 | 11 090 | 10″ | 1″ | 1530 4 | 211.8 | 6.21 | 608.4 | 79 9 | 3.92 |
| 145 | 14.602 | 15 284 | .690 | 12.390 | 1 106 | 65 | 11 090 | 10″ | 1″ | 1662.7 | 227.7 | 6.24 | 658 5 | 86.2 | 3.93 |
| 155 | 14.750 | 15.330 | .736 | 12 390 | 1 180 | .65 | 11 090 | 10″ | 1″ | 1796 8 | 243.6 | 6.28 | 709.0 | 92 5 | 3.94 |
| 165 | 14.896 | 15.377 | .783 | 12 390 | 1.253 | 65 | 11.090 | 10″ | 1″ | 1932 6 | 259.5 | 6 31 | 759.9 | 98.8 | 3.96 |
| 175 | 15.042 | 15.424 | 830 | 12.390 | 1.326 | .65 | 11.090 | 10″ | 1″ | 2071.7 | 275.5 | 6.34 | 811.6 | 105.2 | 3.97 |
| 185 | 15.188 | 15.469 | 875 | 12 390 | 1.399 | .65 | 11.090 | 10″ | 1″ | 2213 5 | 291 5 | 6 38 | 863.9 | 111 7 | 3 98 |
| 195 | 15.334 | 15.513 | .919 | 12.390 | 1.472 | .65 | 11 090 | 10″ | 1″ | 2358 2 | 307.6 | 6 41 | 916 8 | 118.2 | 4.00 |
| 205 | 15.478 | 15.559 | .965 | 12 390 | 1 544 | 65 | 11 090 | 10″ | 1″ | 2505 0 | 323 7 | 6.45 | 970.3 | 124.7 | 4 01 |
| 215 | 15.622 | 15.604 | 1 010 | 12 390 | 1 616 | 65 | 11 090 | 10″ | 1″ | 2654 7 | 339 9 | 6.48 | 1024.5 | 131 3 | 4.03 |
| 225 | 15.764 | 15.650 | 1 056 | 12.390 | 1.687 | 65 | 11 090 | 10″ | 1″ | 2806.2 | 356.0 | 6.51 | 1079.1 | 137.9 | 4 04 |
| 235 | 15.908 | 15.693 | 1 099 | 12.390 | 1 759 | 65 | 11 090 | 10″ | 1″ | 2961 9 | 372 4 | 6 55 | 1134.5 | 144.6 | 4 05 |
| 245 | 16.050 | 15.738 | 1 144 | 12.390 | 1 830 | .65 | 11 090 | 10″ | 1″ | 3119.6 | 388 7 | 6.58 | 1190.6 | 151.3 | 4.06 |
| 255 | 16 192 | 15 781 | 1 187 | 12 390 | 1 901 | .65 | 11 090 | 10″ | 1″ | 3280.0 | 405.1 | 6 61 | 1247.1 | 158 0 | 4.08 |
| 265 | 16.332 | 15.826 | 1.232 | 12.390 | 1 971 | 65 | 11.090 | 10″ | 1″ | 3442.4 | 421 6 | 6.65 | 1304.2 | 164.8 | 4.09 |
| 275 | 16.472 | 15.870 | 1 276 | 12.390 | 2.041 | .65 | 11 090 | 10″ | 1″ | 3607.8 | 438.1 | 6.68 | 1362 0 | 171 6 | 4.10 |
| 285 | 16.614 | 15.912 | 1.318 | 12.390 | 2 112 | .65 | 11 090 | 10″ | 1″ | 3778.1 | 454.8 | 6.71 | 1420.7 | 178.6 | 4.12 |
| 295 | 16.752 | 15.956 | 1.362 | 12 390 | 2 181 | .65 | 11.090 | 10″ | 1″ | 3948.1 | 471.4 | 6.75 | 1479 4 | 185.4 | 4.13 |
| 305 | 16.890 | 16 000 | 1 406 | 12.390 | 2.250 | .65 | 11.090 | 10″ | 1″ | 4121.5 | 488.0 | 6.78 | 1539.1 | 192 4 | 4 14 |
| 325 | 17.164 | 16.087 | 1.493 | 12.390 | 2.387 | .65 | 11.090 | 10″ | 1″ | 4475.9 | 521.6 | 6.84 | 1659.9 | 206.4 | 4.17 |
| 345 | 17.438 | 16 172 | 1.578 | 12.390 | 2.524 | 65 | 11.090 | 10″ | 1″ | 4843.4 | 555.5 | 6.91 | 1783.5 | 220.6 | 4.19 |
| 365 | 17.710 | 16.255 | 1.661 | 12.390 | 2.660 | .65 | 11.090 | 10″ | 1″ | 5221.4 | 589.7 | 6.97 | 1909.1 | 234.9 | 4.22 |
| 385 | 17.978 | 16.340 | 1.746 | 12.390 | 2.794 | .65 | 11.090 | 10″ | 1″ | 5609.4 | 624.0 | 7.04 | 2037.4 | 249.4 | 4.24 |
| 405 | 18.246 | 16.423 | 1.829 | 12.390 | 2.928 | .65 | 11.090 | 10″ | 1″ | 6010.5 | 658.8 | 7.10 | 2168.2 | 264.0 | 4.27 |
| 425 | 18.510 | 16.506 | 1.912 | 12.390 | 3.060 | .65 | 11.090 | 10″ | 1″ | 6420.5 | 693.7 | 7.17 | 2301.0 | 278.8 | 4.29 |

NOTE: For the convenience of the designer beams from 68 lb. to 265 lb. per foot are duplicated on the preceding page in conjunction with those from 30 lb. to 61 lb. per foot.

‡ Special Section for Column core




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

14″

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14" CARNEGIE COLUMNS WITH COVER PLATES

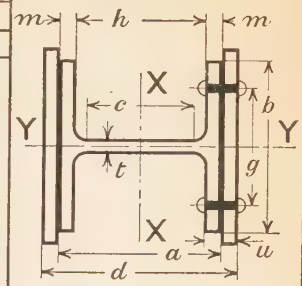
| 2 Cover Plates | Weight per Foot | Area Sq. Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 |
| **14" × 131# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | | | | |
| 16 × 3/8 | 171 8 | 50.5 | 3 99 | 757 | 731 | 705 | 679 | 652 | 626 | 600 | 575 | 551 | 527 | 504 | 482 | 461 | 441 | 421 | 403 |
| 7/16 | 178 6 | 52.5 | 4 01 | 788 | 762 | 735 | 707 | 680 | 653 | 626 | 600 | 575 | 550 | 526 | 504 | 482 | 461 | 440 | 421 |
| 1/2 | 185 4 | 54.5 | 4 04 | 818 | 793 | 765 | 737 | 709 | 681 | 653 | 626 | 600 | 575 | 550 | 526 | 504 | 482 | 461 | 441 |
| 9/16 | 192 2 | 56.5 | 4 06 | 848 | 824 | 795 | 766 | 737 | 708 | 680 | 652 | 625 | 598 | 573 | 548 | 525 | 502 | 480 | 460 |
| 16 × 5/8 | 199 0 | 58.5 | 4 08 | 878 | 855 | 825 | 795 | 765 | 735 | 706 | 677 | 649 | 622 | 596 | 570 | 546 | 522 | 500 | 478 |
| 11/16 | 205 8 | 60.5 | 4 10 | 908 | 885 | 855 | 824 | 793 | 763 | 732 | 703 | 674 | 646 | 618 | 592 | 567 | 543 | 520 | 497 |
| 3/4 | 212.6 | 62.5 | 4 12 | 938 | 916 | 885 | 853 | 822 | 790 | 759 | 728 | 699 | 670 | 642 | 615 | 588 | 563 | 539 | 517 |
| 13/16 | 219.4 | 64.5 | 4 13 | 968 | 947 | 914 | 882 | 849 | 817 | 785 | 753 | 722 | 692 | 663 | 636 | 609 | 583 | 558 | 535 |
| 16 × 7/8 | 226.2 | 66.5 | 4 15 | 998 | 978 | 945 | 911 | 878 | 844 | 811 | 779 | 747 | 717 | 687 | 658 | 630 | 604 | 578 | 554 |
| 15/16 | 233.0 | 68.5 | 4 16 | 1028 | 1008 | 974 | 940 | 905 | 871 | 837 | 804 | 771 | 740 | 709 | 679 | 651 | 623 | 597 | 572 |
| 1" | 239.8 | 70.5 | 4 18 | 1058 | 1039 | 1004 | 969 | 934 | 899 | 864 | 830 | 797 | 764 | 733 | 702 | 673 | 645 | 618 | 592 |
| 1 1/16 | 246.6 | 72.5 | 4.19 | 1088 | 1069 | 1034 | 998 | 962 | 926 | 890 | 855 | 821 | 787 | 755 | 724 | 694 | 665 | 637 | 610 |
| 16 × 1 1/8 | 253.4 | 74.5 | 4 20 | 1118 | 1100 | 1064 | 1027 | 990 | 953 | 916 | 880 | 845 | 811 | 777 | 745 | 714 | 684 | 656 | 629 |
| 1 3/16 | 260.2 | 76 5 | 4.21 | 1148 | 1130 | 1093 | 1055 | 1017 | 979 | 942 | 905 | 869 | 834 | 800 | 767 | 735 | 705 | 675 | 647 |
| 1 1/4 | 267.0 | 78 5 | 4.22 | 1178 | 1161 | 1123 | 1084 | 1045 | 1006 | 968 | 930 | 893 | 857 | 822 | 788 | 756 | 725 | 695 | 666 |
| 1 5/16 | 273.8 | 80 5 | 4.23 | 1208 | 1192 | 1153 | 1113 | 1073 | 1033 | 994 | 956 | 918 | 881 | 845 | 810 | 777 | 745 | 714 | 684 |
| 16 × 1 3/8 | 280.6 | 82 5 | 4.24 | 1238 | 1222 | 1182 | 1142 | 1101 | 1061 | 1020 | 981 | 942 | 904 | 868 | 832 | 798 | 765 | 733 | 703 |
| 1 7/16 | 287.4 | 84 5 | 4.25 | 1268 | 1253 | 1212 | 1171 | 1129 | 1088 | 1047 | 1006 | 967 | 928 | 890 | 854 | 819 | 785 | 753 | 722 |
| 1 1/2 | 294 2 | 86 5 | 4.26 | 1298 | 1284 | 1242 | 1200 | 1157 | 1115 | 1073 | 1032 | 991 | 952 | 913 | 876 | 840 | 806 | 775 | 741 |
| 1 9/16 | 301.0 | 88 5 | 4.27 | 1328 | 1314 | 1272 | 1229 | 1186 | 1142 | 1099 | 1057 | 1016 | 975 | 936 | 898 | 862 | 826 | 792 | 760 |
| 16 × 1 5/8 | 307 8 | 90 5 | 4.28 | 1358 | 1345 | 1302 | 1258 | 1214 | 1170 | 1126 | 1083 | 1040 | 999 | 959 | 920 | 883 | 847 | 812 | 779 |
| 111/16 | 314 6 | 92 5 | 4.29 | 1388 | 1376 | 1332 | 1287 | 1242 | 1197 | 1152 | 1108 | 1065 | 1023 | 982 | 943 | 904 | 867 | 832 | 798 |
| 1 3/4 | 321 4 | 94 5 | 4.29 | 1418 | 1406 | 1361 | 1315 | 1269 | 1223 | 1177 | 1132 | 1088 | 1045 | 1003 | 963 | 924 | 886 | 850 | 815 |
| 113/16 | 328 2 | 96 5 | 4.30 | 1448 | 1437 | 1391 | 1344 | 1297 | 1250 | 1204 | 1158 | 1113 | 1069 | 1027 | 985 | 945 | 907 | 870 | 835 |
| 16 × 1 7/8 | 335.0 | 98 5 | 4.31 | 1478 | 1467 | 1421 | 1373 | 1326 | 1278 | 1231 | 1184 | 1135 | 1093 | 1050 | 1008 | 967 | 928 | 890 | 854 |
| 115/16 | 341 8 | 100 5 | 4.31 | 1508 | 1497 | 1450 | 1401 | 1353 | 1304 | 1256 | 1208 | 1161 | 1116 | 1071 | 1028 | 987 | 947 | 908 | 871 |
| 2" | 348 6 | 102 5 | 4.32 | 1538 | 1528 | 1480 | 1431 | 1381 | 1332 | 1282 | 1234 | 1186 | 1140 | 1095 | 1051 | 1008 | 968 | 928 | 891 |
| **14" × 225# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | | | | |
| 22 × 1 7/16 | 440 0 | 129 4 | 5 30 | 1941 | 1941 | 1941 | 1941 | 1904 | 1854 | 1804 | 1753 | 1701 | 1651 | 1600 | 1551 | 1502 | 1454 | 1407 | 1361 |
| 1 9/16 | 458 7 | 134 9 | 5 34 | 2024 | 2024 | 2024 | 2024 | 1991 | 1939 | 1887 | 1834 | 1781 | 1728 | 1676 | 1625 | 1574 | 1524 | 1475 | 1427 |
| 111/16 | 477.4 | 140 4 | 5 39 | 2106 | 2106 | 2106 | 2106 | 2079 | 2026 | 1972 | 1917 | 1863 | 1808 | 1755 | 1701 | 1649 | 1597 | 1546 | 1497 |
| 113/16 | 496 1 | 145 9 | 5.43 | 2189 | 2189 | 2189 | 2189 | 2166 | 2111 | 2055 | 1999 | 1943 | 1887 | 1831 | 1776 | 1722 | 1669 | 1616 | 1565 |
| 115/16 | 514 8 | 151 4 | 5 46 | 2271 | 2271 | 2271 | 2271 | 2252 | 2195 | 2138 | 2080 | 2022 | 1964 | 1907 | 1850 | 1794 | 1738 | 1684 | 1631 |
| **14" × 325# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | | | | |
| 17 × 1" | 440 6 | 129 6 | 4 37 | 1944 | 1939 | 1879 | 1818 | 1756 | 1694 | 1632 | 1571 | 1512 | 1453 | 1396 | 1341 | 1288 | 1236 | 1187 | 1139 |
| 1 3/16 | 462.2 | 136 0 | 4 40 | 2039 | 2039 | 1977 | 1913 | 1848 | 1784 | 1719 | 1656 | 1594 | 1533 | 1473 | 1415 | 1360 | 1306 | 1254 | 1204 |
| 1 3/8 | 483 9 | 142.3 | 4 42 | 2135 | 2135 | 2073 | 2007 | 1939 | 1872 | 1805 | 1739 | 1674 | 1610 | 1548 | 1487 | 1429 | 1373 | 1318 | 1266 |
| 1 9/16 | 505 6 | 148 7 | 4.45 | 2231 | 2231 | 2171 | 2102 | 2033 | 1963 | 1893 | 1825 | 1757 | 1690 | 1626 | 1563 | 1502 | 1443 | 1386 | 1332 |
| 1 3/4 | 527 3 | 155.1 | 4 47 | 2326 | 2326 | 2268 | 2197 | 2125 | 2052 | 1980 | 1908 | 1838 | 1769 | 1702 | 1636 | 1573 | 1511 | 1452 | 1395 |
| 115/16 | 548 9 | 161 5 | 4 48 | 2422 | 2422 | 2363 | 2289 | 2214 | 2139 | 2064 | 1989 | 1916 | 1844 | 1774 | 1706 | 1640 | 1576 | 1515 | 1456 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

LOADS BY A. I. S. C. SPECIFICATION

# DIMENSIONS AND FUNCTIONS OF 14" CARNEGIE COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per Foot | DIMENSIONS d | b | t | a | h | m | c | g | Riv. | AXIS X - X I | S | r | AXIS Y - Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14" × 131# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | |
| 16 × 3/8 | 171.8 | 14 15/16 | 15.468 | .874 | 14.162 | 12.39 | .886 | 11 09 | 10" | 1" | 1993 | 267 | 6.28 | 803 | 100 | 3 99 |
| 7/16 | 178.6 | 15 1/16 | 15.468 | .874 | 14.162 | 12 39 | .886 | 11 09 | 10" | 1" | 2105 | 280 | 6.33 | 846 | 106 | 4.01 |
| 1/2 | 185.4 | 15 3/16 | 15.468 | .874 | 14 162 | 12 39 | .886 | 11.09 | 10" | 1" | 2219 | 293 | 6.38 | 889 | 111 | 4.04 |
| 9/16 | 192 2 | 15 5/16 | 15.468 | .874 | 14 162 | 12.39 | .886 | 11.09 | 10" | 1" | 2335 | 305 | 6.43 | 931 | 116 | 4.06 |
| 16 × 5/8 | 199.0 | 15 7/16 | 15.468 | .874 | 14.162 | 12.39 | .886 | 11 09 | 10" | 1" | 2452 | 318 | 6.47 | 974 | 122 | 4.08 |
| 11/16 | 205.8 | 15 9/16 | 15 468 | .874 | 14.162 | 12.39 | .886 | 11 09 | 10" | 1" | 2572 | 331 | 6.52 | 1017 | 127 | 4.10 |
| 3/4 | 212.6 | 15 11/16 | 15.468 | .874 | 14 162 | 12 39 | .886 | 11 09 | 10" | 1" | 2694 | 344 | 6.56 | 1059 | 132 | 4.12 |
| 13/16 | 219.4 | 15 13/16 | 15.468 | .874 | 14.162 | 12.39 | .886 | 11.09 | 10" | 1" | 2817 | 357 | 6.61 | 1102 | 138 | 4.13 |
| 16 × 7/8 | 226.2 | 15 15/16 | 15 468 | .874 | 14.162 | 12.39 | .886 | 11 09 | 10" | 1" | 2943 | 370 | 6.65 | 1145 | 143 | 4.15 |
| 15/16 | 233.0 | 16 1/16 | 15 468 | .874 | 14.162 | 12.39 | .886 | 11 09 | 10" | 1" | 3071 | 383 | 6.69 | 1187 | 148 | 4.16 |
| 1" | 239 8 | 16 3/16 | 15 468 | .874 | 14 162 | 12.39 | .886 | 11 09 | 10" | 1" | 3200 | 396 | 6.74 | 1230 | 154 | 4.18 |
| 1 1/16 | 246.6 | 16 5/16 | 15.468 | .874 | 14.162 | 12 39 | 886 | 11 09 | 10" | 1" | 3332 | 409 | 6.78 | 1273 | 159 | 4.19 |
| 16 × 1 1/8 | 253.4 | 16 7/16 | 15 468 | .874 | 14.162 | 12 39 | .886 | 11 09 | 10" | 1" | 3465 | 422 | 6.82 | 1315 | 164 | 4.20 |
| 1 3/16 | 260.2 | 16 9/16 | 15 468 | .874 | 14.162 | 12 39 | .886 | 11.09 | 10" | 1" | 3601 | 436 | 6.86 | 1358 | 170 | 4.21 |
| 1 1/4 | 267 0 | 16 11/16 | 15.468 | .874 | 14 162 | 12 39 | .886 | 11 09 | 10" | 1" | 3739 | 449 | 6.90 | 1401 | 175 | 4.22 |
| 1 5/16 | 273.8 | 16 13/16 | 15 468 | .874 | 14 162 | 12.39 | .886 | 11 09 | 10" | 1" | 3879 | 462 | 6.94 | 1443 | 180 | 4.23 |
| 16 × 1 3/8 | 280.6 | 16 15/16 | 15.468 | .874 | 14.162 | 12.39 | .886 | 11.09 | 10" | 1" | 4021 | 475 | 6.98 | 1486 | 186 | 4.24 |
| 1 7/16 | 287.4 | 17 1/16 | 15.468 | .874 | 14.162 | 12 39 | .886 | 11.09 | 10" | 1" | 4165 | 489 | 7.02 | 1529 | 191 | 4.25 |
| 1 1/2 | 294.2 | 17 3/16 | 15.468 | .874 | 14 162 | 12 39 | .886 | 11 09 | 10" | 1" | 4311 | 502 | 7.06 | 1571 | 196 | 4.26 |
| 1 9/16 | 301.0 | 17 5/16 | 15 468 | .874 | 14.162 | 12.39 | .886 | 11.09 | 10" | 1" | 4459 | 516 | 7.10 | 1614 | 202 | 4.27 |
| 16 × 1 5/8 | 307.8 | 17 7/16 | 15 468 | .874 | 14 162 | 12 39 | .886 | 11 09 | 10" | 1" | 4610 | 530 | 7.14 | 1657 | 207 | 4.28 |
| 11/16 | 314.6 | 17 9/16 | 15 468 | .874 | 14 162 | 12 39 | .886 | 11 09 | 10" | 1" | 4763 | 543 | 7.17 | 1699 | 212 | 4.29 |
| 1 3/4 | 321 4 | 17 11/16 | 15 468 | .874 | 14 162 | 12 39 | .886 | 11.09 | 10" | 1" | 4917 | 557 | 7.21 | 1742 | 218 | 4.29 |
| 13/16 | 328.2 | 17 13/16 | 15 468 | .874 | 14 162 | 12 39 | .886 | 11.09 | 10" | 1" | 5074 | 571 | 7.25 | 1785 | 223 | 4.30 |
| 16 × 1 7/8 | 335.0 | 17 15/16 | 15 468 | .874 | 14 162 | 12 39 | .886 | 11.09 | 10" | 1" | 5234 | 584 | 7.29 | 1827 | 228 | 4.31 |
| 15/16 | 341.8 | 18 1/16 | 15 468 | .874 | 14 162 | 12.39 | .886 | 11 09 | 10" | 1" | 5395 | 598 | 7.33 | 1870 | 234 | 4.31 |
| 2" | 348 6 | 18 3/16 | 15 468 | 874 | 14 162 | 12 39 | .886 | 11.09 | 10" | 1" | 5559 | 612 | 7.36 | 1913 | 239 | 4.32 |
| **14" × 225# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | |
| 22 × 1 7/16 | 440 0 | 18 11/16 | 15 650 | 1 056 | 15.764 | 12 39 | 1.687 | 11 09 | 10" | 1" | 7496 | 804 | 7.61 | 3630 | 330 | 5.30 |
| 1 9/16 | 458 7 | 18 15/16 | 15 650 | 1 056 | 15 764 | 12 39 | 1.687 | 11.09 | 10" | 1" | 7980 | 845 | 7.69 | 3852 | 350 | 5.34 |
| 11/16 | 477 4 | 19 3/16 | 15 650 | 1 056 | 15 764 | 12 39 | 1 687 | 11.09 | 10" | 1" | 8477 | 886 | 7.77 | 4074 | 370 | 5.39 |
| 13/16 | 496 1 | 19 7/16 | 15 650 | 1.056 | 15 764 | 12.39 | 1 687 | 11 09 | 10" | 1" | 8987 | 927 | 7.85 | 4296 | 391 | 5.43 |
| 15/16 | 514 8 | 19 11/16 | 15 650 | 1 056 | 15 764 | 12.39 | 1 687 | 11.09 | 10" | 1" | 9511 | 969 | 7.93 | 4517 | 411 | 5.46 |
| **14" × 325# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | |
| 17 × 1" | 440 6 | 19 3/16 | 16 087 | 1 493 | 17 164 | 12.39 | 2 387 | 11 09 | 10" | 1" | 7283 | 760 | 7.50 | 2479 | 292 | 4.37 |
| 1 3/16 | 462 2 | 19 9/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 7880 | 807 | 7.61 | 2632 | 310 | 4.40 |
| 1 3/8 | 483 9 | 19 15/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 8500 | 854 | 7.73 | 2786 | 328 | 4.42 |
| 1 9/16 | 505 6 | 20 5/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 9144 | 901 | 7.84 | 2939 | 346 | 4.45 |
| 1 3/4 | 527 3 | 20 11/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11.09 | 10" | 1" | 9813 | 950 | 7.95 | 3093 | 364 | 4.47 |
| 15/16 | 548.9 | 21 1/16 | 16 087 | 1 493 | 17 164 | 12.39 | 2.387 | 11.09 | 10" | 1" | 10505 | 999 | 8 07 | 3246 | 382 | 4.48 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

14"

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14" CARNEGIE COLUMNS WITH COVER PLATES

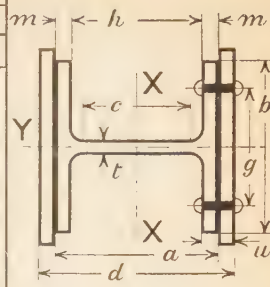
| 2 Cover Plates | Weight per Foot | Area Sq. Inches | Least Radius Gyration | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 |
| **14" × 325# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | | | | |
| 18 × 2" | 569 8 | 167 6 | 4 64 | 2514 | 2514 | 2485 | 2411 | 2336 | 2260 | 2185 | 2110 | 2036 | 1963 | 1892 | 1822 | 1754 | 1689 | 1625 | 1564 |
| 2 3/16 | 592 7 | 174 5 | 4 66 | 2615 | 2615 | 2589 | 2512 | 2435 | 2357 | 2278 | 2201 | 2124 | 2048 | 1974 | 1902 | 1832 | 1763 | 1697 | 1633 |
| 2 3/8 | 615 7 | 181 1 | 4 68 | 2716 | 2716 | 2693 | 2614 | 2534 | 2453 | 2372 | 2292 | 2212 | 2134 | 2057 | 1982 | 1909 | 1839 | 1770 | 1704 |
| 18 × 2 9/16 | 638 6 | 187 8 | 4 70 | 2817 | 2817 | 2797 | 2716 | 2633 | 2550 | 2466 | 2383 | 2301 | 2220 | 2141 | 2063 | 1987 | 1914 | 1843 | 1774 |
| 2 3/4 | 661 6 | 194 6 | 4 72 | 2919 | 2919 | 2902 | 2818 | 2733 | 2647 | 2561 | 2475 | 2390 | 2307 | 2224 | 2144 | 2066 | 1990 | 1917 | 1846 |
| 2 15/16 | 684 5 | 201 3 | 4 74 | 3020 | 3020 | 3007 | 2921 | 2833 | 2745 | 2656 | 2567 | 2480 | 2393 | 2309 | 2226 | 2145 | 2067 | 1991 | 1917 |
| 24 × 1 1/4 | 529 0 | 155 6 | 5 46 | 2334 | 2334 | 2334 | 2334 | 2305 | 2246 | 2186 | 2126 | 2066 | 2006 | 1946 | 1887 | 1829 | 1772 | 1716 | 1661 |
| 1 3/8 | 549 4 | 161 6 | 5 47 | 2424 | 2424 | 2424 | 2424 | 2404 | 2343 | 2283 | 2222 | 2160 | 2098 | 2037 | 1976 | 1917 | 1858 | 1800 | 1743 |
| 1 1/2 | 569 8 | 167 6 | 5 53 | 2514 | 2514 | 2514 | 2514 | 2503 | 2442 | 2379 | 2316 | 2253 | 2189 | 2126 | 2064 | 2002 | 1942 | 1882 | 1824 |
| 1 5/8 | 590 2 | 173 6 | 5 58 | 2604 | 2604 | 2604 | 2604 | 2601 | 2538 | 2474 | 2409 | 2344 | 2279 | 2214 | 2150 | 2087 | 2024 | 1963 | 1902 |
| 24 × 1 3/4 | 610 6 | 179 6 | 5 63 | 2694 | 2694 | 2694 | 2694 | 2694 | 2634 | 2569 | 2502 | 2436 | 2369 | 2303 | 2237 | 2171 | 2107 | 2044 | 1982 |
| 1 7/8 | 631 0 | 185 6 | 5 68 | 2784 | 2784 | 2784 | 2784 | 2784 | 2731 | 2664 | 2596 | 2528 | 2460 | 2392 | 2324 | 2257 | 2191 | 2126 | 2062 |
| 2" | 651 4 | 191 6 | 5 72 | 2874 | 2874 | 2874 | 2874 | 2874 | 2826 | 2758 | 2688 | 2619 | 2549 | 2479 | 2409 | 2341 | 2273 | 2206 | 2140 |
| 2 1/8 | 671 8 | 197 6 | 5 76 | 2964 | 2964 | 2964 | 2964 | 2964 | 2922 | 2852 | 2781 | 2710 | 2638 | 2566 | 2495 | 2425 | 2355 | 2286 | 2219 |
| **14" × 425# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | | | | |
| 18 × 2 5/16 | 708 0 | 208 2 | 4 67 | 3124 | 3124 | 3094 | 3003 | 2911 | 2818 | 2725 | 2632 | 2541 | 2450 | 2362 | 2276 | 2192 | 2110 | 2031 | 1955 |
| 2 1/2 | 731 0 | 215 0 | 4 69 | 3225 | 3225 | 3199 | 3106 | 3011 | 2915 | 2820 | 2724 | 2630 | 2537 | 2446 | 2357 | 2271 | 2187 | 2105 | 2027 |
| 2 11/16 | 753 9 | 221 7 | 4 71 | 3326 | 3326 | 3305 | 3209 | 3112 | 3013 | 2915 | 2817 | 2720 | 2625 | 2531 | 2440 | 2350 | 2264 | 2180 | 2099 |
| 18 × 2 7/8 | 776 9 | 228 5 | 4 72 | 3427 | 3427 | 3408 | 3309 | 3209 | 3108 | 3007 | 2906 | 2807 | 2709 | 2612 | 2518 | 2426 | 2337 | 2251 | 2167 |
| 3 1/16 | 799 8 | 235 2 | 4 74 | 3529 | 3529 | 3514 | 3413 | 3310 | 3207 | 3103 | 3000 | 2897 | 2797 | 2697 | 2601 | 2506 | 2415 | 2326 | 2240 |
| 3 1/4 | 822 8 | 242 0 | 4 75 | 3630 | 3630 | 3617 | 3514 | 3409 | 3302 | 3195 | 3089 | 2984 | 2881 | 2779 | 2680 | 2583 | 2489 | 2397 | 2309 |
| 18 × 3 7/16 | 845 7 | 248 7 | 4 76 | 3731 | 3731 | 3721 | 3615 | 3507 | 3398 | 3288 | 3180 | 3072 | 2965 | 2861 | 2759 | 2660 | 2563 | 2469 | 2378 |
| 3 5/8 | 868 7 | 255 5 | 4 77 | 3832 | 3832 | 3824 | 3716 | 3605 | 3493 | 3381 | 3270 | 3159 | 3050 | 2943 | 2838 | 2736 | 2637 | 2541 | 2448 |
| 3 13/16 | 891 6 | 262 2 | 4 79 | 3934 | 3934 | 3931 | 3820 | 3707 | 3593 | 3475 | 3364 | 3251 | 3140 | 3030 | 2923 | 2818 | 2716 | 2617 | 2522 |
| 4" | 914 6 | 269 0 | 4 80 | 4035 | 4035 | 4035 | 3921 | 3806 | 3689 | 3572 | 3455 | 3339 | 3225 | 3112 | 3003 | 2895 | 2791 | 2690 | 2592 |
| 24 × 1 5/8 | 690 2 | 203 0 | 5 46 | 3045 | 3045 | 3045 | 3045 | 3019 | 2943 | 2866 | 2789 | 2711 | 2633 | 2556 | 2480 | 2405 | 2331 | 2258 | 2187 |
| 1 3/4 | 710 6 | 209 0 | 5 50 | 3135 | 3135 | 3135 | 3135 | 3116 | 3039 | 2960 | 2881 | 2802 | 2724 | 2643 | 2565 | 2488 | 2412 | 2338 | 2265 |
| 1 7/8 | 731 0 | 215 0 | 5 55 | 3225 | 3225 | 3225 | 3225 | 3215 | 3137 | 3057 | 2976 | 2895 | 2814 | 2734 | 2654 | 2575 | 2497 | 2421 | 2346 |
| 2" | 751 4 | 221 0 | 5 59 | 3315 | 3315 | 3315 | 3315 | 3313 | 3233 | 3152 | 3069 | 2987 | 2904 | 2822 | 2740 | 2660 | 2580 | 2502 | 2425 |
| 24 × 2 1/8 | 771 8 | 227 0 | 5 63 | 3405 | 3405 | 3405 | 3405 | 3405 | 3329 | 3247 | 3163 | 3079 | 2994 | 2910 | 2827 | 2745 | 2664 | 2584 | 2505 |
| 2 1/4 | 792 2 | 233 0 | 5 67 | 3495 | 3495 | 3495 | 3495 | 3495 | 3426 | 3342 | 3257 | 3171 | 3085 | 3000 | 2914 | 2830 | 2747 | 2666 | 2585 |
| 2 3/8 | 812 6 | 239 0 | 5 70 | 3585 | 3585 | 3585 | 3585 | 3585 | 3522 | 3435 | 3349 | 3261 | 3174 | 3086 | 2999 | 2913 | 2828 | 2745 | 2663 |
| 2 1/2 | 833 0 | 245 0 | 5 74 | 3675 | 3675 | 3675 | 3675 | 3675 | 3619 | 3532 | 3443 | 3354 | 3265 | 3176 | 3087 | 3000 | 2913 | 2828 | 2744 |
| 24 × 2 5/8 | 853 4 | 251 0 | 5 77 | 3765 | 3765 | 3765 | 3765 | 3765 | 3714 | 3626 | 3536 | 3445 | 3354 | 3263 | 3173 | 3083 | 2995 | 2908 | 2822 |
| 2 3/4 | 873 8 | 257 0 | 5 80 | 3855 | 3855 | 3855 | 3855 | 3855 | 3810 | 3720 | 3628 | 3536 | 3443 | 3351 | 3259 | 3167 | 3077 | 2989 | 2901 |
| 2 7/8 | 894 2 | 263 0 | 5 83 | 3945 | 3945 | 3945 | 3945 | 3945 | 3906 | 3814 | 3721 | 3627 | 3533 | 3439 | 3345 | 3252 | 3160 | 3069 | 2980 |
| 3" | 914 6 | 269 0 | 5 85 | 4035 | 4035 | 4035 | 4035 | 4035 | 4000 | 3907 | 3812 | 3716 | 3620 | 3524 | 3428 | 3333 | 3239 | 3147 | 3056 |

Loads to right of heavy vertical lines are for Secondary Members ONLY.

LOADS BY A. I. S. C. SPECIFICATION

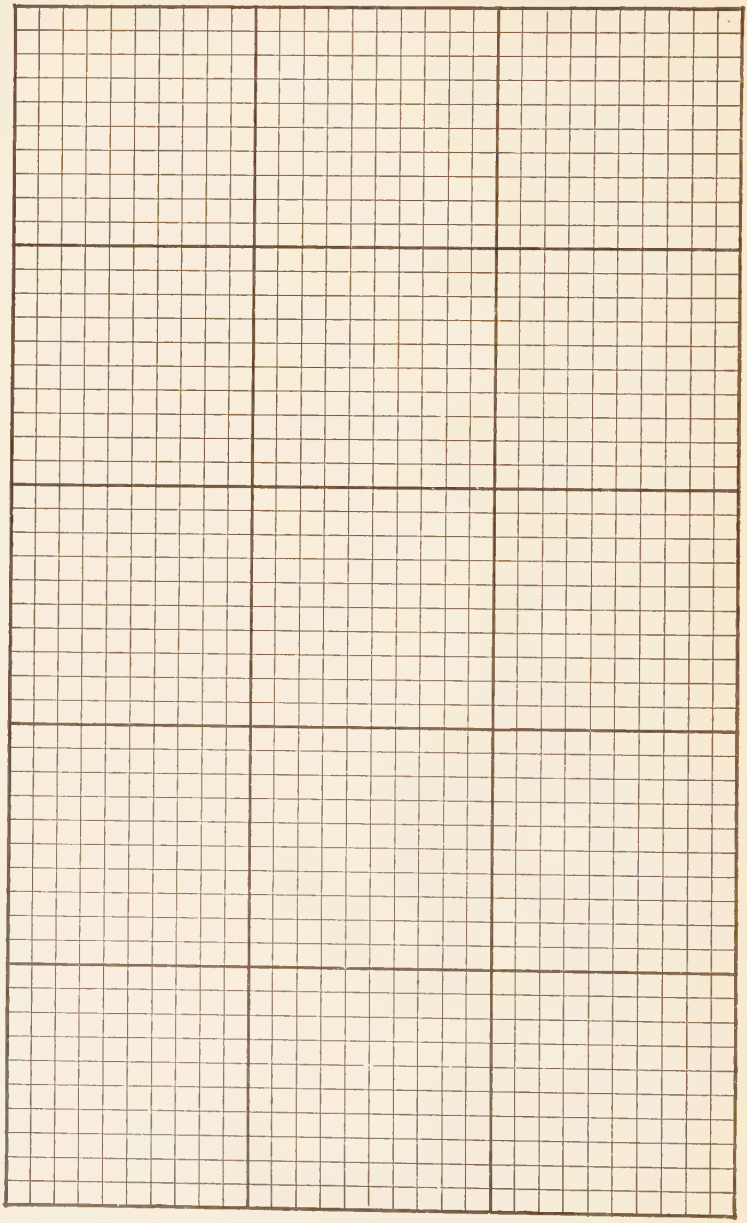
# DIMENSIONS AND FUNCTIONS OF 14" CARNEGIE COLUMNS WITH COVER PLATES

| 2 Cover Plates | Weight per Foot | DIMENSIONS | | | | | | | | | AXIS X - X | | | AXIS Y - Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | d | b | t | a | h | m | c | g | Riv. | I | S | r | I | S | r |
| **14" × 325# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | |
| 18 × 2" | 569 8 | 21 3/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 11109 | 1050 | 8 14 | 3604 | 400 | 4 64 |
| 2 3/16 | 592 7 | 21 9/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 11878 | 1103 | 8 25 | 3786 | 421 | 4 66 |
| 2 3/8 | 615 7 | 21 15/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 12674 | 1157 | 8 37 | 3968 | 441 | 4 68 |
| 18 × 2 9/16 | 638 6 | 22 5/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 13498 | 1211 | 8 48 | 4151 | 461 | 4 70 |
| 2 3/4 | 661 6 | 22 11/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 14350 | 1266 | 8 59 | 4333 | 481 | 4 72 |
| 2 15/16 | 684 5 | 23 1/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 15230 | 1322 | 8 76 | 4515 | 502 | 4 74 |
| 24 × 1 1/4 | 529 0 | 19 11/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 9570 | 973 | 7 84 | 4540 | 378 | 5 40 |
| 1 3/8 | 549 4 | 19 15/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 10157 | 1020 | 7 93 | 4828 | 402 | 5 47 |
| 1 1/2 | 569 8 | 20 3/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 10760 | 1067 | 8 01 | 5116 | 426 | 5 53 |
| 1 5/8 | 590 2 | 20 7/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 11377 | 1115 | 8 10 | 5404 | 450 | 5 58 |
| 24 × 1 3/4 | 610 6 | 20 11/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 12010 | 1162 | 8 18 | 5692 | 474 | 5 63 |
| 1 7/8 | 631 0 | 20 15/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 12658 | 1210 | 8 26 | 5980 | 498 | 5 68 |
| 2" | 651 4 | 21 3/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 13322 | 1259 | 8 34 | 6268 | 522 | 5 72 |
| 2 1/8 | 671 8 | 21 7/16 | 16 087 | 1 493 | 17 164 | 12 39 | 2 387 | 11 09 | 10" | 1" | 14002 | 1308 | 8 42 | 6556 | 546 | 5 76 |
| **14" × 425# CARNEGIE BEAM SECTION** | | | | | | | | | | | | | | | | |
| 18 × 2 5/16 | 708 0 | 23 3/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 15481 | 1338 | 8 62 | 4549 | 505 | 4 67 |
| 2 1/2 | 731 0 | 23 9/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 16309 | 1395 | 8 73 | 4738 | 526 | 4 69 |
| 2 11/16 | 753 9 | 23 15/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 17347 | 1453 | 8 84 | 4913 | 546 | 4 71 |
| 18 × 2 7/8 | 776 9 | 24 5/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 18325 | 1511 | 8 96 | 5096 | 566 | 4 72 |
| 3 1/16 | 799 8 | 24 11/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 19333 | 1570 | 9 07 | 5278 | 586 | 4 74 |
| 3 1/4 | 822 8 | 25 1/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 20373 | 1629 | 9 18 | 5460 | 607 | 4 75 |
| 18 × 3 7/16 | 845 7 | 25 7/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 21445 | 1690 | 9 29 | 5642 | 627 | 4 76 |
| 3 5/8 | 868 7 | 25 13/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 22548 | 1751 | 9 39 | 5825 | 647 | 4 77 |
| 3 13/16 | 891 6 | 26 3/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 23684 | 1812 | 9 50 | 6007 | 667 | 4 79 |
| 4" | 914 6 | 26 9/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 24854 | 1875 | 9 61 | 6189 | 688 | 4 80 |
| 24 × 1 5/8 | 690 2 | 21 13/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 14343 | 1318 | 8 41 | 6045 | 504 | 5 46 |
| 1 3/4 | 710 6 | 22 1/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 15062 | 1369 | 8 49 | 6333 | 528 | 5 50 |
| 1 7/8 | 731 0 | 22 5/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 15797 | 1419 | 8 57 | 6621 | 552 | 5 55 |
| 2" | 751 4 | 22 9/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 16548 | 1470 | 8 65 | 6909 | 576 | 5 59 |
| 24 × 2 1/8 | 771 8 | 22 13/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 17317 | 1522 | 8 73 | 7197 | 600 | 5 63 |
| 2 1/4 | 792 2 | 23 1/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 18102 | 1573 | 8 81 | 7485 | 624 | 5 67 |
| 2 3/8 | 812 6 | 23 5/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 18905 | 1626 | 8 89 | 7773 | 648 | 5 70 |
| 2 1/2 | 833 0 | 23 9/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 19726 | 1678 | 8 97 | 8061 | 672 | 5 74 |
| 24 × 2 5/8 | 853 4 | 23 13/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 20564 | 1731 | 9 05 | 8349 | 696 | 5 77 |
| 2 3/4 | 873 8 | 24 1/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 21419 | 1784 | 9 13 | 8637 | 720 | 5 80 |
| 2 7/8 | 894 2 | 24 5/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 22293 | 1838 | 9 21 | 8925 | 744 | 5 83 |
| 3" | 914 6 | 24 9/16 | 16 506 | 1 912 | 18 510 | 12 39 | 3 060 | 11 09 | 10" | 1" | 23185 | 1892 | 9 28 | 9213 | 768 | 5 85 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

## NOTES and DIAGRAMS



# Part IV
# Section 13

## Plate and Angle Columns

## Plate and Angle Columns with Cover Plates

## Channel and Plate Columns

Dimensions

Technical Functions

Allowable Concentric Loads

by

A. I. S. C. Specification

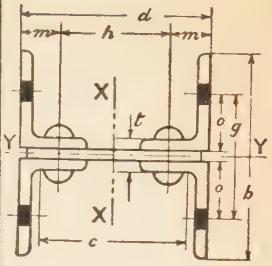
# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 8½" PLATE AND ANGLE COLUMNS

| 1 Web Plate | 4 Angles | Weight Per Foot | Area Sq. in. | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 4 | 8 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 20 | 22 | 24 | 26 | 30 |
| 8×1/4 | 2½×2½×1/4 | 23.2 | 6.76 | .96 | 101 | 78 | 65 | 59 | 54 | 49 | 45 | 41 | 38 | ... | ... | ... | ... | ... | ... | ... |
| | 3 ×2½×1/4 | 24.8 | 7.24 | 1.19 | 109 | 96 | 83 | 77 | 72 | 66 | 62 | 57 | 53 | ... | ... | ... | ... | ... | ... | ... |
| | 5/16 | 29.2 | 8.48 | 1.23 | 127 | 114 | 100 | 93 | 87 | 81 | 75 | 70 | 65 | ... | ... | ... | ... | ... | ... | ... |
| | 3½×2½×1/4 | 26.4 | 7.76 | 1.44 | 116 | 112 | 101 | 95 | 90 | 85 | 80 | 75 | 70 | 66 | 62 | 55 | 49 | ... | ... | ... |
| | 5/16 | 31.2 | 9.12 | 1.49 | 137 | 133 | 120 | 114 | 108 | 102 | 96 | 90 | 85 | 80 | 76 | 67 | 60 | ... | ... | ... |
| | 3/8 | 35.6 | 10.44 | 1.52 | 157 | 154 | 140 | 132 | 125 | 118 | 112 | 106 | 100 | 94 | 89 | 79 | 70 | ... | ... | ... |
| | 3½×3 ×1/4 | 28.4 | 8.24 | 1.40 | 124 | 118 | 105 | 99 | 93 | 87 | 82 | 77 | 73 | 68 | 64 | 56 | 50 | ... | ... | ... |
| | 5/16 | 33.2 | 9.72 | 1.44 | 146 | 140 | 126 | 119 | 112 | 106 | 100 | 94 | 88 | 83 | 78 | 69 | 61 | ... | ... | ... |
| | 3/8 | 38.4 | 11.20 | 1.47 | 168 | 163 | 147 | 139 | 131 | 124 | 117 | 110 | 103 | 97 | 92 | 81 | 72 | ... | ... | ... |
| | 4 ×3 ×1/4 | 30.0 | 8.76 | 1.64 | 131 | 131 | 122 | 116 | 110 | 105 | 100 | 95 | 90 | 85 | 80 | 72 | 65 | ... | ... | ... |
| | 5/16 | 35.6 | 10.36 | 1.69 | 155 | 155 | 146 | 139 | 133 | 127 | 120 | 113 | 109 | 103 | 98 | 88 | 79 | ... | ... | ... |
| | 3/8 | 40.8 | 11.92 | 1.72 | 179 | 179 | 169 | 162 | 154 | 147 | 140 | 133 | 127 | 120 | 114 | 103 | 93 | ... | ... | ... |
| | 4 ×3½×3/8 | 43.2 | 12.68 | 1.68 | 190 | 190 | 178 | 170 | 162 | 154 | 147 | 139 | 132 | 125 | 119 | 107 | 96 | ... | ... | ... |
| | 5 ×3½×5/16 | 41.6 | 12.24 | 2.15 | 184 | 184 | 184 | 182 | 176 | 171 | 165 | 159 | 153 | 147 | 141 | 130 | 120 | ... | ... | ... |
| | 3/8 | 48.4 | 14.20 | 2.19 | 213 | 213 | 213 | 213 | 206 | 199 | 193 | 186 | 179 | 172 | 166 | 153 | 141 | ... | ... | ... |
| 8×5/16 | 2½×2½×5/16 | 28.5 | 8.38 | .98 | 126 | 98 | 82 | 75 | 69 | 63 | 57 | 52 | 48 | ... | ... | ... | ... | ... | ... | ... |
| | 3 ×2½×5/16 | 30.9 | 8.98 | 1.22 | 135 | 120 | 105 | 98 | 91 | 85 | 79 | 73 | 68 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 34.9 | 10.18 | 1.26 | 153 | 139 | 122 | 114 | 106 | 99 | 92 | 86 | 80 | ... | ... | ... | ... | ... | ... | ... |
| | 3½×2½×5/16 | 32.9 | 9.62 | 1.47 | 144 | 140 | 126 | 119 | 113 | 106 | 100 | 94 | 89 | 84 | 79 | 70 | 62 | ... | ... | ... |
| | 3/8 | 37.3 | 10.94 | 1.51 | 164 | 161 | 146 | 138 | 131 | 124 | 117 | 110 | 104 | 98 | 92 | 82 | 73 | ... | ... | ... |
| | 3½×3 ×5/16 | 34.9 | 10.22 | 1.42 | 153 | 147 | 132 | 124 | 117 | 110 | 103 | 97 | 91 | 85 | 80 | 71 | 63 | ... | ... | ... |
| | 3/8 | 40.1 | 11.70 | 1.46 | 176 | 170 | 153 | 144 | 137 | 129 | 121 | 114 | 107 | 101 | 95 | 84 | 75 | ... | ... | ... |
| | 4 ×3 ×5/16 | 37.3 | 10.86 | 1.67 | 163 | 163 | 152 | 145 | 138 | 132 | 125 | 119 | 113 | 107 | 101 | 91 | 82 | ... | ... | ... |
| | 3/8 | 42.5 | 12.42 | 1.71 | 186 | 186 | 175 | 168 | 160 | 153 | 145 | 138 | 132 | 125 | 118 | 107 | 96 | ... | ... | ... |
| | 4 ×3½×3/8 | 44.9 | 13.18 | 1.67 | 198 | 198 | 184 | 176 | 168 | 160 | 152 | 144 | 137 | 130 | 123 | 110 | 99 | ... | ... | ... |
| | 5 ×3½×5/16 | 43.3 | 12.74 | 2.13 | 191 | 191 | 191 | 189 | 183 | 177 | 170 | 164 | 158 | 152 | 146 | 135 | 124 | 114 | 105 | 89 |
| | 3/8 | 50.1 | 14.70 | 2.17 | 221 | 221 | 221 | 219 | 213 | 206 | 198 | 191 | 184 | 177 | 171 | 158 | 145 | 134 | 123 | 105 |
| 8×3/8 | 3 ×2½×3/8 | 36.6 | 10.68 | 1.25 | 160 | 145 | 127 | 119 | 111 | 103 | 96 | 89 | 83 | 77 | 72 | ... | ... | ... | ... | ... |
| | 3 ×3 ×3/8 | 39.0 | 11.44 | 1.21 | 172 | 152 | 133 | 124 | 115 | 107 | 99 | 92 | 86 | 80 | 74 | ... | ... | ... | ... | ... |
| | 3½×2½×3/8 | 39.0 | 11.44 | 1.50 | 172 | 168 | 152 | 144 | 136 | 128 | 121 | 114 | 108 | 102 | 96 | ... | ... | ... | ... | ... |
| | 3½×3 ×3/8 | 41.8 | 12.20 | 1.45 | 183 | 177 | 159 | 150 | 142 | 134 | 126 | 118 | 111 | 104 | 98 | ... | ... | ... | ... | ... |
| | 7/16 | 46.6 | 13.60 | 1.49 | 204 | 199 | 180 | 170 | 161 | 152 | 143 | 135 | 127 | 120 | 113 | 100 | 89 | ... | ... | ... |
| | 4 ×3 ×3/8 | 44.2 | 12.92 | 1.70 | 194 | 194 | 182 | 174 | 166 | 158 | 151 | 143 | 136 | 129 | 123 | 110 | 99 | ... | ... | ... |
| | 7/16 | 49.4 | 14.48 | 1.73 | 217 | 217 | 206 | 197 | 188 | 180 | 171 | 163 | 155 | 147 | 140 | 126 | 114 | ... | ... | ... |
| | 4 ×3½×3/8 | 46.6 | 13.68 | 1.66 | 205 | 205 | 191 | 182 | 174 | 165 | 157 | 149 | 141 | 134 | 127 | 114 | 102 | ... | ... | ... |
| | 5 ×3½×3/8 | 51.8 | 15.20 | 2.15 | 228 | 228 | 228 | 226 | 219 | 212 | 204 | 197 | 190 | 182 | 175 | 162 | 149 | 137 | 126 | 107 |
| | 7/16 | 58.2 | 17.12 | 2.19 | 257 | 257 | 257 | 256 | 248 | 240 | 232 | 224 | 216 | 208 | 200 | 185 | 171 | 157 | 145 | 123 |

Unequal Angles have short leg against web plate.
Weights given do not include rivets or other details.
Loads to right of heavy verticallines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 8½" PLATE AND ANGLE COLUMNS

| 1 Web Plate | 4 Angles | DIMENSIONS d | b | t | h | m | o | g | c | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8×1/4 | 2½ × 2½ × 1/4 | 8½ | 5¼ | ¾ | 5¾ | 1⅜ | 1⅜ | 3 | 7½ | ¾ | 73 | 17.1 | 3.28 | 6.2 | 2.4 | .96 |
| | 3 × 2½ × 1/4 | " | 6¼ | ¾ | " | " | 1¾ | 3¾ | 7⅜ | " | 82 | 19.2 | 3.35 | 10.3 | 3.3 | 1.19 |
| | | " | 6¼ | ⅞ | " | " | " | " | 7¼ | " | 97 | 22.8 | 3.38 | 12.9 | 4.1 | 1.23 |
| | 3½ × 2½ × 1/4 | " | 7¼ | ¾ | " | " | 2 | 4¼ | 7⅜ | " | 90 | 21.1 | 3.40 | 16.0 | 4.4 | 1.44 |
| | 5/16 | " | " | ⅞ | " | " | " | " | 7¼ | " | 108 | 25.4 | 3.43 | 20.2 | 5.6 | 1.49 |
| | 3/8 | " | " | 1 | " | " | " | " | 7⅛ | " | 124 | 29.1 | 3.44 | 24.2 | 6.7 | 1.52 |
| | 3½ × 3 × 1/4 | " | " | ¾ | 5 | 1¾ | " | " | 7¼ | ⅞ | 91 | 21.3 | 3.31 | 16.1 | 4.4 | 1.40 |
| | 5/16 | " | " | ⅞ | " | " | " | " | 7⅛ | " | 108 | 25.5 | 3.34 | 20.2 | 5.6 | 1.44 |
| | 3/8 | " | " | 1 | " | " | " | " | 7 | " | 126 | 29.6 | 3.35 | 24.3 | 6.7 | 1.47 |
| | 4 × 3 × 1/4 | 8½ | 8¼ | ¾ | 5 | 1¾ | 2½ | 5¼ | 7¼ | ⅞ | 100 | 23.5 | 3.38 | 23.7 | 5.8 | 1.64 |
| | 5/16 | " | " | ⅞ | " | " | " | " | 7⅛ | " | 119 | 28.0 | 3.38 | 29.6 | 7.2 | 1.69 |
| | 3/8 | " | " | 1 | " | " | " | " | 7 | " | 138 | 32.4 | 3.40 | 35.4 | 8.6 | 1.72 |
| | 4 × 3½ × 3/8 | " | " | 1 | 4½ | 2 | " | " | 7 | " | 138 | 32.6 | 3.30 | 35.8 | 8.7 | 1.68 |
| | 5 × 3½ × 5/16 | " | 10¼ | ⅞ | " | " | 3 | 6¼ | 7 | " | 141 | 33.1 | 3.39 | 56.5 | 11.0 | 2.15 |
| | 3/8 | " | " | 1 | " | " | " | " | 6⅞ | " | 164 | 38.6 | 3.40 | 67.8 | 13.2 | 2.19 |
| 8×5/16 | 2½ × 2½ × 5/16 | 8½ | 5 5/16 | 15/16 | 5¾ | 1⅜ | 1⅜ | 3 1/16 | 7⅜ | ¾ | 89 | 21.0 | 3.26 | 8.1 | 3.1 | .98 |
| | 3 × 2½ × 5/16 | " | 6 5/16 | 15/16 | " | " | 1¾ | 3 13/16 | 7¼ | " | 99 | 23.4 | 3.33 | 13.3 | 4.2 | 1.22 |
| | 3/8 | " | 6 5/16 | 1 1/16 | " | " | " | " | 7⅛ | " | 113 | 26.7 | 3.34 | 16.2 | 5.1 | 1.26 |
| | 3½ × 2½ × 5/16 | " | 7 5/16 | 15/16 | " | " | 2 | 4 5/16 | 7¼ | " | 110 | 25.9 | 3.38 | 20.7 | 5.6 | 1.47 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 7⅛ | " | 126 | 29.7 | 3.40 | 24.9 | 6.8 | 1.51 |
| | 3½ × 3 × 5/16 | " | " | 15/16 | 5 | 1¾ | " | " | 7⅛ | ⅞ | 111 | 26.1 | 3.30 | 20.7 | 5.7 | 1.42 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 7 | " | 128 | 30.1 | 3.31 | 25.0 | 6.8 | 1.46 |
| | 4 × 3 × 5/16 | 8½ | 8 5/16 | 15/16 | 5 | 1¾ | 2½ | 5 5/16 | 7⅛ | ⅞ | 121 | 28.6 | 3.34 | 30.3 | 7.3 | 1.67 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 7 | " | 140 | 33.0 | 3.36 | 36.3 | 8.7 | 1.71 |
| | 4 × 3½ × 3/8 | " | " | 1 1/16 | 4½ | 2 | " | " | 7 | " | 141 | 33.2 | 3.27 | 36.7 | 8.8 | 1.67 |
| | 5 × 3½ × 5/16 | " | 10 5/16 | 15/16 | " | " | 3 | 6 5/16 | 7 | " | 143 | 33.7 | 3.35 | 57.6 | 11.2 | 2.13 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 6⅞ | " | 167 | 39.2 | 3.37 | 69.2 | 13.4 | 2.17 |
| 8×3/8 | 3 × 2½ × 3/8 | 8½ | 6⅜ | 1⅛ | 5¾ | 1⅜ | 1¾ | 3⅞ | 7⅛ | ¾ | 116 | 27.3 | 3.29 | 16.8 | 5.3 | 1.25 |
| | 3 × 3 × 3/8 | " | 6⅜ | " | 5 | 1¾ | " | " | 7⅛ | ⅞ | 118 | 27.8 | 3.21 | 16.8 | 5.3 | 1.21 |
| | 3½ × 2½ × 3/8 | " | 7⅜ | " | 5¾ | 1⅜ | 2 | 4⅜ | 7⅛ | ¾ | 129 | 30.4 | 3.36 | 25.6 | 6.9 | 1.50 |
| | 3½ × 3 × 3/8 | " | " | " | 5 | 1¾ | " | " | 7 | ⅞ | 131 | 30.8 | 3.26 | 25.7 | 7.0 | 1.45 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 6⅞ | " | 147 | 34.5 | 3.29 | 30.0 | 8.1 | 1.49 |
| | 4 × 3 × 3/8 | 8½ | 8⅜ | 1⅛ | 5 | 1¾ | 2½ | 5⅜ | 7 | ⅞ | 143 | 33.7 | 3.33 | 37.2 | 8.9 | 1.70 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 6⅞ | " | 161 | 37.9 | 3.34 | 43.5 | 10.4 | 1.73 |
| | 4 × 3½ × 3/8 | " | " | 1⅛ | 4½ | 2 | " | " | 7 | " | 144 | 33.8 | 3.24 | 37.7 | 9.0 | 1.66 |
| | 5 × 3½ × 3/8 | " | 10⅜ | 1⅛ | " | " | 3 | 6⅜ | 7 | " | 169 | 39.8 | 3.33 | 70.5 | 13.6 | 2.15 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 6⅞ | " | 191 | 45.0 | 3.34 | 82.2 | 15.8 | 2.19 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

Unequal Angles have short leg against web plate.
Dimensions *h*, *m*, *o* and *g* can be varied considerably.

# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 10½" PLATE AND ANGLE COLUMNS

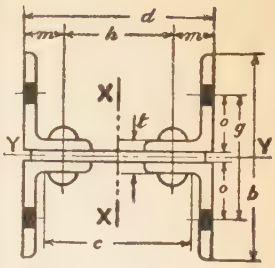
| 1 Web Plate | 4 Angles | Weight Per Foot | Area Sq. in. | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
| 10×¼ | 3½×2½×¼ | 28.1 | 8.26 | 1.39 | 124 | 123 | 118 | 111 | 105 | 93 | 82 | 72 | 63 | 56 | ... | ... | ... | ... | ... | ... |
| | 5/16 | 32.9 | 9.62 | 1.45 | 144 | 144 | 139 | 132 | 125 | 112 | 99 | 88 | 78 | 69 | ... | ... | ... | ... | ... | ... |
| | 3/8 | 37.3 | 10.94 | 1.49 | 164 | 164 | 160 | 153 | 145 | 130 | 115 | 102 | 91 | 81 | ... | ... | ... | ... | ... | ... |
| | 3½×3 ×¼ | 30.1 | 8.74 | 1.36 | 131 | 130 | 123 | 117 | 110 | 97 | 85 | 75 | 66 | 58 | ... | ... | ... | ... | ... | ... |
| | 5/16 | 34.9 | 10.22 | 1.41 | 153 | 153 | 146 | 139 | 131 | 117 | 103 | 91 | 80 | 71 | ... | ... | ... | ... | ... | ... |
| | 3/8 | 40.1 | 11.70 | 1.44 | 176 | 176 | 169 | 161 | 152 | 135 | 120 | 106 | 94 | 83 | ... | ... | ... | ... | ... | ... |
| | 4 ×3 ×¼ | 31.7 | 9.26 | 1.60 | 139 | 139 | 139 | 133 | 127 | 115 | 103 | 93 | 83 | 74 | 66 | ... | ... | ... | ... | ... |
| | 5/16 | 37.3 | 10.86 | 1.65 | 163 | 163 | 163 | 158 | 151 | 137 | 124 | 112 | 100 | 90 | 81 | ... | ... | ... | ... | ... |
| | 3/8 | 42.5 | 12.42 | 1.69 | 186 | 186 | 186 | 182 | 175 | 159 | 144 | 130 | 117 | 105 | 95 | ... | ... | ... | ... | ... |
| | 4 ×3½×3/8 | 44.9 | 13.18 | 1.65 | 198 | 198 | 198 | 192 | 184 | 167 | 151 | 135 | 122 | 109 | 98 | ... | ... | ... | ... | ... |
| | 5 ×3½×5/16 | 43.3 | 12.74 | 2.11 | 191 | 191 | 191 | 191 | 191 | 182 | 170 | 157 | 145 | 133 | 123 | 113 | 104 | 96 | 88 | ... |
| | 3/8 | 50.1 | 14.70 | 2.15 | 221 | 221 | 221 | 221 | 221 | 212 | 198 | 183 | 170 | 156 | 144 | 133 | 122 | 112 | 103 | ... |
| 10×5/16 | 3½×2½×5/16 | 35.0 | 10.25 | 1.42 | 154 | 154 | 147 | 140 | 132 | 117 | 104 | 92 | 81 | 71 | 63 | ... | ... | ... | ... | ... |
| | 3/8 | 39.4 | 11.57 | 1.47 | 174 | 174 | 168 | 160 | 152 | 136 | 121 | 107 | 95 | 84 | 75 | ... | ... | ... | ... | ... |
| | 3½×3 ×5/16 | 37.0 | 10.85 | 1.38 | 163 | 162 | 154 | 146 | 138 | 122 | 107 | 94 | 83 | 73 | 64 | ... | ... | ... | ... | ... |
| | 3/8 | 42.2 | 12.33 | 1.42 | 185 | 185 | 177 | 168 | 159 | 141 | 125 | 110 | 97 | 86 | 76 | ... | ... | ... | ... | ... |
| | 4 ×3 ×5/16 | 39.4 | 11.49 | 1.62 | 172 | 172 | 172 | 166 | 159 | 144 | 129 | 116 | 104 | 93 | 84 | ... | ... | ... | ... | ... |
| | 3/8 | 44.6 | 13.05 | 1.67 | 196 | 196 | 196 | 191 | 183 | 166 | 150 | 135 | 122 | 109 | 98 | ... | ... | ... | ... | ... |
| | 4 ×3½×3/8 | 47.0 | 13.81 | 1.63 | 207 | 207 | 207 | 200 | 191 | 173 | 156 | 140 | 126 | 113 | 101 | ... | ... | ... | ... | ... |
| | 5 ×3½×5/16 | 45.4 | 13.37 | 2.08 | 201 | 201 | 201 | 201 | 201 | 190 | 177 | 163 | 151 | 138 | 127 | 117 | 107 | 98 | 90 | ... |
| | 3/8 | 52.2 | 15.33 | 2.12 | 230 | 230 | 230 | 230 | 230 | 220 | 205 | 190 | 175 | 161 | 148 | 136 | 125 | 116 | 106 | ... |
| 10×3/8 | 3½×3 ×3/8 | 44.4 | 12.95 | 1.41 | 194 | 194 | 185 | 176 | 166 | 148 | 130 | 115 | 101 | 89 | 79 | ... | ... | ... | ... | ... |
| | 4 ×3 ×3/8 | 46.8 | 13.67 | 1.65 | 205 | 205 | 205 | 199 | 190 | 173 | 156 | 140 | 126 | 113 | 102 | ... | ... | ... | ... | ... |
| | 4 ×3½×3/8 | 49.2 | 14.43 | 1.62 | 217 | 217 | 217 | 208 | 199 | 181 | 163 | 146 | 131 | 117 | 105 | ... | ... | ... | ... | ... |
| | 5 ×3½×3/8 | 54.4 | 15.95 | 2.10 | 239 | 239 | 239 | 239 | 239 | 228 | 212 | 196 | 181 | 166 | 153 | 140 | 129 | 118 | 109 | ... |
| | 7/16 | 60.8 | 17.87 | 2.14 | 268 | 268 | 268 | 268 | 268 | 257 | 240 | 222 | 206 | 189 | 174 | 160 | 147 | 136 | 125 | ... |
| | ½ | 67.2 | 19.75 | 2.19 | 296 | 296 | 296 | 296 | 296 | 287 | 268 | 249 | 231 | 213 | 197 | 181 | 167 | 154 | 142 | ... |
| | 6 ×4 ×3/8 | 62.0 | 18.19 | 2.56 | 273 | 273 | 273 | 273 | 273 | 273 | 264 | 249 | 235 | 220 | 206 | 192 | 179 | 167 | 156 | ... |
| | 7/16 | 70.0 | 20.47 | 2.61 | 307 | 307 | 307 | 307 | 307 | 307 | 299 | 283 | 267 | 251 | 235 | 220 | 205 | 192 | 179 | 167 |
| | ½ | 77.6 | 22.75 | 2.65 | 341 | 341 | 341 | 341 | 341 | 341 | 335 | 317 | 299 | 281 | 264 | 247 | 231 | 216 | 202 | 189 |
| 10×½ | 6 ×4 ×½ | 81.8 | 24.00 | 2.62 | 360 | 360 | 360 | 360 | 360 | 360 | 352 | 333 | 314 | 295 | 276 | 258 | 242 | 226 | 211 | 197 |
| | 9/16 | 89.4 | 26.24 | 2.66 | 394 | 394 | 394 | 394 | 394 | 394 | 387 | 366 | 346 | 325 | 305 | 286 | 268 | 251 | 234 | 219 |
| | 5/8 | 97.0 | 28.44 | 2.69 | 427 | 427 | 427 | 427 | 427 | 427 | 421 | 399 | 377 | 355 | 333 | 313 | 293 | 274 | 257 | 241 |
| 10×5/8 | 6 ×4 ×5/8 | 101.3 | 29.69 | 2.68 | 445 | 445 | 445 | 445 | 445 | 445 | 438 | 416 | 393 | 370 | 347 | 325 | 305 | 285 | 267 | 250 |
| | 3/4 | 115.7 | 34.01 | 2.75 | 510 | 510 | 510 | 510 | 510 | 510 | 507 | 482 | 456 | 430 | 405 | 380 | 357 | 335 | 314 | 294 |
| 10×¾ | 6 ×4 ×¾ | 119.9 | 35.26 | 2.74 | 529 | 529 | 529 | 529 | 529 | 529 | 525 | 499 | 472 | 445 | 419 | 393 | 369 | 346 | 324 | 303 |
| | 7/8 | 134.3 | 39.42 | 2.80 | 591 | 591 | 591 | 591 | 591 | 591 | 591 | 563 | 533 | 504 | 475 | 447 | 420 | 394 | 370 | 347 |

Unequal Angles have short leg against web plate.
Weights given do not include rivets or other details.
Loads to right of heavy vertical lines are for Secondary Members ONLY.

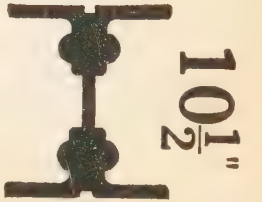
# DIMENSIONS AND FUNCTIONS OF 10½" PLATE AND ANGLE COLUMNS

| 1 Web Plate | 4 Angles | DIMENSIONS d | b | t | h | m | o | g | c | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10×¼ | 3½×2½×¼ | 10½ | 7¼ | ¾ | 7¾ | 1⅜ | 2 | 4 ¼ | 9⅜ | ¾ | 148 | 28.2 | 4.23 | 16 0 | 4.4 | 1.39 |
| | 5/16 | " | " | 7/8 | " | " | " | " | 9¼ | " | 176 | 33 5 | 4.28 | 20 2 | 5.6 | 1.45 |
| | 3/8 | " | " | 1 | " | " | " | " | 9⅛ | " | 203 | 38.6 | 4.30 | 24.2 | 6.7 | 1.49 |
| | 3½×3 ×¼ | " | " | ¾ | 7 | 1¾ | " | " | 9½ | ⅞ | 150 | 28.6 | 4.15 | 16 1 | 4.4 | 1.36 |
| | 5/16 | " | " | 7/8 | " | " | " | " | 9⅛ | " | 179 | 34.2 | 4.19 | 20 2 | 5.6 | 1.41 |
| | 3/8 | " | " | 1 | " | " | " | " | 9 | " | 208 | 39.6 | 4.21 | 24.3 | 6.7 | 1.44 |
| | 4 ×3 ×¼ | 10½ | 8¼ | ¾ | 7 | 1¾ | 2½ | 5 ¼ | 9¼ | ⅞ | 164 | 31.2 | 4.20 | 23.7 | 5.8 | 1.60 |
| | 5/16 | " | " | 7/8 | " | " | " | " | 9⅛ | " | 196 | 37.3 | 4.24 | 29.6 | 7.2 | 1.65 |
| | 3/8 | " | " | 1 | " | " | " | " | 9 | " | 227 | 43.2 | 4.27 | 35 4 | 8.6 | 1.69 |
| | 4 ×3½×3/8 | " | " | 1 | 6½ | 2 | " | " | 9 | " | 229 | 43.7 | 4.17 | 35 8 | 8.7 | 1.65 |
| | 5 ×3½×5/16 | " | 10¼ | 7/8 | " | " | 3 | 6 ¼ | 9 | " | 231 | 44 0 | 4.26 | 56 5 | 11.0 | 2.11 |
| | 3/8 | " | " | 1 | " | " | " | " | 8⅞ | " | 269 | 51 0 | 4.27 | 67 8 | 13 3 | 2 15 |
| 10×5/16 | 3½×2½×5/16 | 10½ | 7 5/16 | 15/16 | 7¾ | 1⅜ | 2 | 4 5/16 | 9¼ | ¾ | 181 | 34.5 | 4.20 | 20.7 | 5.7 | 1.42 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 9⅛ | " | 208 | 39 6 | 4.24 | 24 9 | 6.8 | 1.47 |
| | 3½×3 ×5/16 | " | " | 15/16 | 7 | 1¾ | " | " | 9⅛ | ⅞ | 185 | 35 2 | 4.13 | 20 7 | 5.7 | 1.38 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 9 | " | 213 | 40 4 | 4.15 | 25.0 | 6.8 | 1.42 |
| | 4 ×3 ×5/16 | 10½ | 8 5/16 | 15/16 | 7 | 1¾ | 2½ | 5 5/16 | 9⅛ | ⅞ | 201 | 38.3 | 4.18 | 30.3 | 7.3 | 1.62 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 9 | " | 232 | 44.2 | 4.22 | 36.3 | 8 7 | 1.67 |
| | 4 ×3½×3/8 | " | " | " | 6½ | 2 | " | " | 9 | " | 235 | 44.7 | 4.19 | 36.7 | 8.9 | 1.63 |
| | 5 ×3½×5/16 | " | 10 5/16 | 15/16 | " | " | 3 | 6 5/16 | 9 | " | 236 | 45.0 | 4.20 | 57.6 | 11.2 | 2.08 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 8⅞ | " | 274 | 52 2 | 4.23 | 69 2 | 13.4 | 2.12 |
| 10×⅜ | 3½×3 ×⅜ | 10½ | 7⅜ | 1⅛ | 7 | 1¾ | 2 | 4 ⅜ | 9 | ⅞ | 218 | 41.6 | 4.11 | 25.7 | 7.0 | 1.41 |
| | 4 ×3 ×⅜ | " | 8⅜ | " | " | " | 2½ | 5 ⅜ | 9 | " | 237 | 45.2 | 4.17 | 37.2 | 8.9 | 1.65 |
| | 4 ×3½×⅜ | " | " | " | 6½ | 2 | " | " | 9 | " | 240 | 45.7 | 4.08 | 37.7 | 9 0 | 1.62 |
| | 5 ×3½×⅜ | 10½ | 10⅜ | 1⅛ | 6½ | 2 | 3 | 6 ⅜ | 8⅞ | ⅞ | 279 | 53.2 | 4.18 | 70.5 | 13 6 | 2.10 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 8¾ | " | 315 | 60 0 | 4.20 | 82.2 | 15.8 | 2.14 |
| | ½ | " | " | 1⅜ | " | " | " | " | 8⅝ | " | 349 | 66.6 | 4.21 | 94.6 | 18 2 | 2.19 |
| | 6 ×4 ×⅜ | " | 12⅜ | 1⅛ | 5½ | 2½ | 3½ | 7 ⅜ | 8¾ | " | 319 | 60.8 | 4.19 | 119 2 | 19.3 | 2.56 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 8⅝ | ⅞ | 361 | 68.8 | 4.20 | 139.0 | 22.5 | 2.61 |
| | ½ | " | " | 1⅜ | " | " | " | " | 8½ | " | 401 | 76 4 | 4.20 | 159 7 | 25 8 | 2.65 |
| 10×½ | 6 ×4 ×½ | 10½ | 12½ | 1½ | 5½ | 2½ | 3½ | 7 ½ | 8½ | ⅞ | 412 | 78.5 | 4.14 | 164.9 | 26 3 | 2.62 |
| | 9/16 | " | " | 1 5/8 | " | " | " | " | 8⅜ | " | 451 | 85.9 | 4.15 | 185.5 | 29.7 | 2.66 |
| | 5/8 | " | " | 1¾ | " | " | " | " | 8¼ | " | 490 | 93.3 | 4.15 | 206.1 | 33.0 | 2.69 |
| 10×⅝ | 6 ×4 ×⅝ | 10½ | 12⅝ | 1⅞ | 5½ | 2½ | 3½ | 7 ⅝ | 8¼ | ⅞ | 500 | 95.3 | 4.10 | 212.9 | 33.7 | 2.68 |
| | ¾ | " | " | 2 1/8 | " | " | " | " | 8 | " | 569 | 108.4 | 4.09 | 256.9 | 40.7 | 2.75 |
| 10×¾ | 6 ×4 ×¾ | 10½ | 12¾ | 2¼ | 5½ | 2½ | 3½ | 7 ¾ | 8 | ⅞ | 580 | 110 3 | 4.05 | 265.4 | 41.6 | 2.74 |
| | ⅞ | " | " | 2½ | " | " | " | " | 7¾ | " | 646 | 123 0 | 4.05 | 309 6 | 48 6 | 2.80 |

Unequal angles have short leg against web plate.
Dimensions *h*, *m*, *o* and *g* can be varied considerably.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration



# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 12½" PLATE AND ANGLE COLUMNS [For 12½" Columns with Cover Plates see following pages]

| 1 Web Plate | 4 Angles | Weight Per Foot | Area Sq. in. | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 |
| 12×¼ | 3½×2½×¼ | 29 8 | 8.76 | 1.36 | 131 | 124 | 110 | 97 | 86 | 75 | 66 | 58 | 51 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 39 0 | 11 44 | 1 45 | 172 | 165 | 149 | 133 | 118 | 104 | 92 | 82 | 73 | ... | ... | ... | ... | ... | ... | ... |
| | 3½×3 ×¼ | 31 8 | 9 24 | 1.32 | 139 | 129 | 114 | 100 | 88 | 76 | 67 | 59 | 52 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 41.8 | 12.20 | 1.41 | 183 | 175 | 157 | 139 | 123 | 108 | 95 | 84 | 74 | ... | ... | ... | ... | ... | ... | ... |
| | 4 ×3 ×¼ | 33.4 | 9.76 | 1.56 | 146 | 145 | 132 | 119 | 107 | 95 | 85 | 76 | 68 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 44.2 | 12.92 | 1 66 | 194 | 194 | 180 | 164 | 148 | 133 | 120 | 108 | 97 | ... | ... | ... | ... | ... | ... | ... |
| | 4 ×3½×3/8 | 46 6 | 13 68 | 1.62 | 205 | 205 | 189 | 171 | 154 | 138 | 124 | 111 | 100 | ... | ... | ... | ... | ... | ... | ... |
| | 5 ×3½×5/16 | 45.0 | 13.24 | 2.07 | 199 | 199 | 199 | 188 | 175 | 161 | 149 | 137 | 125 | 115 | 105 | 96 | 89 | ... | ... | ... |
| | 3/8 | 51.8 | 15 20 | 2 11 | 228 | 228 | 228 | 217 | 202 | 187 | 173 | 159 | 146 | 134 | 124 | 114 | 105 | ... | ... | ... |
| 12×5/16 | 3½×2½×5/16 | 37 2 | 10 87 | 1 38 | 163 | 154 | 138 | 122 | 107 | 94 | 83 | 73 | 64 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 41 6 | 12 19 | 1 43 | 183 | 176 | 158 | 140 | 124 | 110 | 97 | 86 | 76 | ... | ... | ... | ... | ... | ... | ... |
| | 3½×3 ×5/16 | 39 2 | 11.47 | 1 34 | 172 | 161 | 143 | 126 | 110 | 96 | 84 | 74 | 65 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 44 4 | 12 95 | 1.39 | 194 | 184 | 165 | 146 | 129 | 113 | 99 | 88 | 78 | ... | ... | ... | ... | ... | ... | ... |
| | 4 ×3 ×5/16 | 41.6 | 12.11 | 1.58 | 182 | 181 | 165 | 149 | 134 | 120 | 107 | 96 | 85 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 46 8 | 13 67 | 1 63 | 205 | 205 | 189 | 172 | 155 | 139 | 125 | 112 | 100 | ... | ... | ... | ... | ... | ... | ... |
| | 4 ×3½×3/8 | 49 2 | 14 43 | 1 59 | 217 | 216 | 197 | 178 | 160 | 143 | 128 | 115 | 102 | ... | ... | ... | ... | ... | ... | ... |
| | 5 ×3½×5/16 | 47.6 | 13 99 | 2 03 | 210 | 210 | 210 | 197 | 182 | 168 | 155 | 142 | 130 | 119 | 109 | 100 | 92 | ... | ... | ... |
| | 3/8 | 54.4 | 15 95 | 2 08 | 239 | 239 | 239 | 227 | 211 | 195 | 180 | 165 | 152 | 139 | 128 | 118 | 108 | ... | ... | ... |
| 12×3/8 | 4 ×3 ×3/8 | 49 3 | 14 42 | 1.61 | 216 | 216 | 198 | 180 | 162 | 145 | 130 | 116 | 104 | ... | ... | ... | ... | ... | ... | ... |
| | 4 ×3½×3/8 | 51.7 | 15 18 | 1 57 | 228 | 226 | 206 | 186 | 167 | 149 | 133 | 119 | 106 | ... | ... | ... | ... | ... | ... | ... |
| | 5 ×3½×3/8 | 56 9 | 16 70 | 2 05 | 251 | 251 | 251 | 236 | 219 | 202 | 186 | 171 | 156 | 143 | 131 | 120 | 111 | ... | ... | ... |
| | 7/16 | 63.3 | 18 62 | 2.10 | 279 | 279 | 279 | 266 | 247 | 229 | 211 | 194 | 178 | 164 | 150 | 138 | 127 | ... | ... | ... |
| | ½ | 69.7 | 20 50 | 2.15 | 308 | 308 | 308 | 295 | 275 | 256 | 237 | 218 | 201 | 185 | 170 | 156 | 144 | ... | ... | ... |
| | 6 ×4 ×3/8 | 64 5 | 18.94 | 2.51 | 284 | 284 | 284 | 284 | 273 | 257 | 241 | 226 | 211 | 197 | 184 | 171 | 159 | 148 | 138 | 129 |
| | 7/16 | 72.5 | 21 22 | 2 56 | 318 | 318 | 318 | 318 | 309 | 291 | 274 | 257 | 240 | 224 | 209 | 195 | 182 | 170 | 158 | 148 |
| | ½ | 80 1 | 23 50 | 2.61 | 353 | 353 | 353 | 353 | 344 | 325 | 306 | 288 | 270 | 252 | 236 | 220 | 206 | 192 | 179 | 168 |
| 12×½ | 5 ×3½×½ | 74 8 | 22 00 | 2 11 | 330 | 330 | 330 | 315 | 293 | 271 | 250 | 230 | 212 | 194 | 179 | 164 | 151 | ... | ... | ... |
| | 5/8 | 87 6 | 25 68 | 2 19 | 385 | 385 | 385 | 372 | 348 | 324 | 300 | 277 | 256 | 236 | 217 | 200 | 185 | ... | ... | ... |
| | 6 ×4 ×½ | 85 2 | 25 00 | 2 57 | 375 | 375 | 375 | 375 | 364 | 344 | 323 | 303 | 284 | 265 | 248 | 231 | 215 | 201 | 188 | 175 |
| | 9/16 | 92 8 | 27 24 | 2 61 | 409 | 409 | 409 | 409 | 399 | 377 | 355 | 334 | 313 | 293 | 273 | 255 | 238 | 223 | 208 | 194 |
| | 5/8 | 100 4 | 29 44 | 2 65 | 442 | 442 | 442 | 442 | 433 | 410 | 387 | 364 | 342 | 320 | 300 | 280 | 261 | 245 | 229 | 214 |
| 12×5/8 | 6 ×4 ×5/8 | 105 5 | 30 94 | 2.62 | 464 | 464 | 464 | 464 | 453 | 429 | 404 | 380 | 356 | 333 | 312 | 291 | 272 | 254 | 237 | 222 |
| | ¾ | 119 9 | 35 26 | 2.70 | 529 | 529 | 529 | 529 | 522 | 495 | 468 | 441 | 415 | 389 | 364 | 341 | 319 | 299 | 280 | 262 |
| 12×¾ | 6 ×4 ×¾ | 125 0 | 36 76 | 2.69 | 551 | 551 | 551 | 551 | 544 | 516 | 487 | 459 | 431 | 404 | 379 | 354 | 332 | 310 | 290 | 272 |
| | 7/8 | 139.4 | 40 92 | 2 75 | 614 | 614 | 614 | 614 | 611 | 579 | 549 | 518 | 487 | 457 | 430 | 403 | 377 | 353 | 331 | 311 |
| | 6 ×6 ×¾ | 145 4 | 42 76 | 2 51 | 641 | 641 | 641 | 641 | 616 | 581 | 545 | 510 | 477 | 445 | 414 | 386 | 359 | 335 | 312 | 291 |
| | 7/8 | 163.0 | 47 92 | 2.57 | 719 | 719 | 719 | 719 | 697 | 658 | 620 | 581 | 544 | 508 | 474 | 443 | 413 | 385 | 360 | 335 |

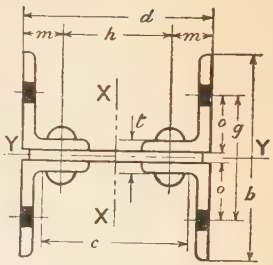
Unequal Angles have short leg against web plate.
Weights given do not include rivets or other details.
Loads to right of heavy verticallines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 12½" PLATE AND ANGLE COLUMNS

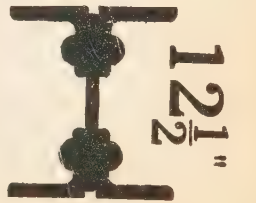
[For 12½" Columns with Cover Plates see following pages]

| 1 Web Plate | 4 Angles | DIMENSIONS d | b | t | h | m | o | g | c | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12×¼ | 3½×2½×¼ | 12½ | 7¼ | ¾ | 9¾ | 1⅜ | 2 | 4¼ | 11⅜ | ¾ | 222 | 36 | 5.04 | 16.0 | 4.4 | 1.36 |
| | 3/8 | " | " | 1 | " | " | " | " | 11⅛ | " | 304 | 49 | 5.15 | 24.2 | 6.7 | 1.45 |
| | 3½×3×¼ | " | " | ¾ | 9 | 1¾ | " | " | 11¼ | ⅞ | 227 | 36 | 4.96 | 16.1 | 4.4 | 1.32 |
| | 3/8 | " | " | 1 | " | " | " | " | 11 | " | 313 | 50 | 5.07 | 24.3 | 6.7 | 1.41 |
| | 4 ×3 ×¼ | 12½ | 8¼ | ¾ | 9 | 1¾ | 2½ | 5¼ | 11¼ | ⅞ | 247 | 40 | 5.03 | 23.7 | 5.8 | 1.56 |
| | 3/8 | " | " | 1 | " | " | " | " | 11 | " | 341 | 55 | 5.14 | 35.4 | 8.6 | 1.66 |
| | 4 ×3½×⅜ | " | " | 1 | 8½ | 2 | " | " | 11 | " | 347 | 56 | 5.03 | 35.8 | 8.7 | 1.62 |
| | 5 ×3½×5/16 | " | 10¼ | ⅞ | " | " | 3 | 6¼ | 11 | " | 347 | 56 | 5.12 | 56.5 | 11.0 | 2.07 |
| | 3/8 | " | " | 1 | " | " | " | " | 10⅞ | " | 403 | 65 | 5.15 | 67.8 | 13.3 | 2.11 |
| 12×5/16 | 3½×2½×5/16 | 12½ | 7 5/16 | 15/16 | 9¾ | 1⅜ | 2 | 4 5/16 | 11¼ | ¾ | 273 | 44 | 5.01 | 20.7 | 5.7 | 1.38 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 11⅛ | " | 313 | 50 | 5.07 | 24.9 | 6.8 | 1.43 |
| | 3½×3×5/16 | " | " | 15/16 | 9 | 1¾ | " | " | 11⅛ | ⅞ | 280 | 45 | 4.94 | 20.7 | 5.7 | 1.34 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 11 | " | 323 | 52 | 4.91 | 25.0 | 6.8 | 1.39 |
| | 4 ×3 ×5/16 | 12½ | 8 5/16 | 15/16 | 9 | 1¾ | 2½ | 5 5/16 | 11⅛ | ⅞ | 304 | 49 | 5.01 | 30.3 | 7.3 | 1.58 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 11 | " | 350 | 56 | 5.06 | 36.3 | 8.7 | 1.63 |
| | 4 ×3½×⅜ | " | " | " | 8½ | 2 | " | " | 11 | " | 356 | 57 | 4.96 | 36.7 | 8.9 | 1.59 |
| | 5 ×3½×5/16 | " | 10 5/16 | 15/16 | " | " | 3 | 6 5/16 | 11 | " | 356 | 57 | 5.04 | 57.6 | 11.2 | 2.03 |
| | 3/8 | " | " | 1 1/16 | " | " | " | " | 10⅞ | " | 412 | 66 | 5.08 | 69.2 | 13.4 | 2.08 |
| 12×⅜ | 4 ×3 ×⅜ | 12½ | 8⅜ | 1⅛ | 9 | 1¾ | 2½ | 5⅜ | 11 | ⅞ | 359 | 58 | 4.99 | 37.2 | 8.9 | 1.61 |
| | 4 ×3½×⅜ | " | " | " | 8½ | 2 | " | " | 11 | " | 365 | 58 | 4.90 | 37.7 | 9.0 | 1.57 |
| | 5 ×3½×⅜ | " | 10⅜ | " | " | " | 3 | 6⅜ | 10⅞ | " | 421 | 67 | 5.02 | 70.5 | 13.6 | 2.05 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 10¾ | " | 476 | 76 | 5.05 | 82.2 | 15.8 | 2.10 |
| | ½ | " | " | 1⅜ | " | " | " | " | 10⅝ | " | 526 | 84 | 5.07 | 94.6 | 18.2 | 2.15 |
| | 6 ×4 ×⅜ | 12½ | 12⅜ | 1⅛ | 7½ | 2½ | 3½ | 7⅜ | 10¾ | ⅞ | 481 | 77 | 5.04 | 119.2 | 19.3 | 2.51 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 10⅝ | " | 544 | 87 | 5.06 | 139.0 | 22.5 | 2.56 |
| | ½ | " | " | 1⅜ | " | " | " | " | 10½ | " | 605 | 97 | 5.07 | 159.7 | 25.8 | 2.61 |
| 12×½ | 5 ×3½×½ | 12½ | 10½ | 1½ | 8½ | 2 | 3 | 6½ | 10⅝ | ⅞ | 544 | 87 | 4.97 | 98.3 | 18.7 | 2.11 |
| | 5/8 | " | " | 1¾ | " | " | " | " | 10⅜ | " | 643 | 103 | 5.01 | 123.0 | 23.9 | 2.19 |
| | 6 ×4 ×½ | " | 12½ | 1½ | 7½ | 2½ | 3½ | 7½ | 10½ | " | 623 | 100 | 4.99 | 164.9 | 26.4 | 2.57 |
| | 9/16 | " | " | 1⅝ | " | " | " | " | 10⅜ | " | 683 | 109 | 5.01 | 185.5 | 29.7 | 2.61 |
| | 5/8 | " | " | 1¾ | " | " | " | " | 10¼ | " | 741 | 119 | 5.02 | 206.1 | 33.0 | 2.65 |
| 12×5/8 | 6 ×4 ×5/8 | 12½ | 12⅝ | 1⅞ | 7½ | 2½ | 3½ | 7⅝ | 10¼ | ⅞ | 759 | 122 | 4.95 | 212.9 | 33.7 | 2.62 |
| | ¾ | " | " | 2⅛ | " | " | " | " | 10 | " | 867 | 139 | 4.96 | 256.9 | 40.7 | 2.70 |
| 12×¾ | 6 ×4 ×¾ | 12½ | 12¾ | 2¼ | 7½ | 2½ | 3½ | 7¾ | 10 | ⅞ | 885 | 142 | 4.91 | 265.4 | 41.7 | 2.69 |
| | 7/8 | " | " | 2½ | " | " | " | " | 9¾ | " | 987 | 158 | 4.91 | 309.6 | 48.6 | 2.75 |
| | 6 ×6 ×¾ | " | " | 2¼ | 5½ | 3½ | " | " | 10 | " | 895 | 143 | 4.57 | 269.4 | 42.3 | 2.51 |
| | 7/8 | " | " | 2½ | " | " | " | " | 9¾ | " | 999 | 160 | 4.57 | 315.2 | 49.5 | 2.57 |

Unequal Angles have short leg against web plate.
Dimensions *h*, *m*, *o* and *g* can be varied considerably.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration



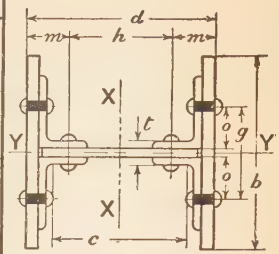
## ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 12½" PLATE AND ANGLE COLUMNS WITH COVER PLATES

| 1 Web Plate | 4 Angles | 2 Cover Plates | Weight Per Foot | Area Sq. in. | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 44 |
| 12×3/8 | 6×4×3/8 | 14× 3/8 | 100.2 | 29.44 | 3.14 | 442 | 442 | 439 | 420 | 400 | 380 | 361 | 342 | 324 | 306 | 289 | 273 | 258 | 244 | ... | ... |
| | 3/8 | 1/2 | 112.1 | 32.94 | 3.25 | 494 | 494 | 494 | 476 | 455 | 434 | 413 | 392 | 372 | 352 | 334 | 316 | 299 | 283 | ... | ... |
| | 7/16 | 1/2 | 120.1 | 35.22 | 3.23 | 528 | 528 | 528 | 508 | 485 | 462 | 440 | 418 | 396 | 375 | 355 | 336 | 318 | 301 | ... | ... |
| | 1/2 | 1/2 | 127.7 | 37.50 | 3.22 | 563 | 563 | 563 | 540 | 516 | 491 | 467 | 444 | 421 | 398 | 377 | 357 | 338 | 319 | ... | ... |
| 12×1/2 | 6×4×1/2 | 14× 1/2 | 132.8 | 39.00 | 3.18 | 585 | 585 | 584 | 559 | 533 | 508 | 482 | 457 | 433 | 410 | 388 | 367 | 347 | 328 | ... | ... |
| | 1/2 | 5/8 | 144.7 | 42.50 | 3.26 | 638 | 638 | 638 | 615 | 588 | 561 | 534 | 507 | 481 | 456 | 432 | 409 | 387 | 366 | ... | ... |
| | 9/16 | 5/8 | 152.3 | 44.74 | 3.25 | 671 | 671 | 671 | 646 | 618 | 589 | 561 | 532 | 505 | 479 | 453 | 429 | 406 | 385 | ... | ... |
| | 5/8 | 5/8 | 159.9 | 46.94 | 3.24 | 704 | 704 | 704 | 678 | 647 | 617 | 587 | 558 | 529 | 501 | 474 | 449 | 425 | 402 | ... | ... |
| 12×5/8 | 6×4×5/8 | 14× 5/8 | 165.0 | 48.44 | 3.21 | 727 | 727 | 727 | 697 | 665 | 634 | 602 | 572 | 542 | 513 | 485 | 459 | 434 | 411 | ... | ... |
| | 5/8 | 3/4 | 176.9 | 51.94 | 3.27 | 779 | 779 | 779 | 753 | 719 | 686 | 653 | 621 | 590 | 559 | 529 | 501 | 475 | 449 | ... | ... |
| | 5/8 | 7/8 | 188.9 | 55.44 | 3.33 | 832 | 832 | 832 | 808 | 774 | 740 | 705 | 670 | 637 | 605 | 574 | 544 | 516 | 488 | ... | ... |
| | 5/8 | 1 | 200.7 | 58.94 | 3.37 | 884 | 884 | 884 | 863 | 827 | 791 | 755 | 719 | 684 | 650 | 617 | 585 | 555 | 526 | ... | ... |
| 12×3/4 | 6×4×3/4 | 14× 3/4 | 196.4 | 57.76 | 3.25 | 866 | 866 | 866 | 835 | 798 | 761 | 724 | 687 | 652 | 618 | 585 | 554 | 524 | 497 | ... | ... |
| | 3/4 | 7/8 | 208.4 | 61.26 | 3.30 | 919 | 919 | 919 | 891 | 852 | 814 | 775 | 737 | 700 | 664 | 629 | 596 | 565 | 536 | ... | ... |
| | 3/4 | 1 | 220.2 | 64.76 | 3.34 | 971 | 971 | 971 | 946 | 906 | 865 | 825 | 785 | 746 | 708 | 672 | 637 | 604 | 572 | ... | ... |
| | 6×4×7/8 | 14× 7/8 | 227.8 | 65.42 | 3.29 | 981 | 981 | 981 | 950 | 909 | 867 | 826 | 785 | 746 | 707 | 670 | 635 | 601 | 570 | ... | ... |
| | 7/8 | 1 | 234.6 | 68.92 | 3.33 | 1034 | 1034 | 1034 | 1005 | 963 | 919 | 876 | 833 | 792 | 752 | 713 | 676 | 641 | 607 | ... | ... |
| 12×5/8 | 6×4×5/8 | 14×1 1/8 | 212.6 | 62.44 | 3.41 | 937 | 937 | 937 | 919 | 882 | 843 | 805 | 767 | 730 | 694 | 659 | 626 | 594 | 564 | 535 | ... |
| | 5/8 | 1 1/4 | 224.5 | 65.94 | 3.45 | 989 | 989 | 989 | 975 | 935 | 895 | 855 | 816 | 777 | 739 | 703 | 668 | 634 | 602 | 572 | ... |
| | 5/8 | 1 3/8 | 236.3 | 69.44 | 3.48 | 1042 | 1042 | 1042 | 1030 | 989 | 947 | 905 | 865 | 824 | 784 | 746 | 709 | 674 | 640 | 608 | ... |
| | 5/8 | 1 1/2 | 248.3 | 72.94 | 3.51 | 1094 | 1094 | 1094 | 1085 | 1042 | 999 | 956 | 912 | 870 | 829 | 788 | 750 | 713 | 678 | 643 | ... |
| | 6×4×5/8 | 14×1 5/8 | 260.3 | 76.44 | 3.54 | 1147 | 1147 | 1147 | 1140 | 1096 | 1051 | 1006 | 961 | 917 | 874 | 832 | 792 | 753 | 716 | 680 | ... |
| | 5/8 | 1 3/4 | 272.3 | 79.94 | 3.56 | 1199 | 1199 | 1199 | 1194 | 1149 | 1102 | 1055 | 1009 | 962 | 917 | 874 | 831 | 791 | 753 | 715 | ... |
| | 5/8 | 1 7/8 | 283.9 | 83.44 | 3.58 | 1252 | 1252 | 1252 | 1249 | 1202 | 1153 | 1105 | 1056 | 1008 | 962 | 917 | 873 | 830 | 790 | 751 | ... |
| | 5/8 | 2 | 295.9 | 86.94 | 3.60 | 1304 | 1304 | 1304 | 1304 | 1255 | 1205 | 1155 | 1104 | 1055 | 1006 | 959 | 913 | 869 | 828 | 788 | 713 |

Columns above heavy horizontal line have no metal above 1" thick.
Unequal Angles have short leg against web plate.
Weights given do not include rivets or other details.
Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 12½" PLATE AND ANGLE COLUMNS WITH COVER PLATES

| 1 Web Plate | 4 Angles | 2 Cover Plates | DIMENSIONS d | b | t | h | m | o | g | c | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12×3/8 | 6×4×3/8 | 14×3/8 | 13¼ | 14 | 1⅛ | 7½ | 2½ | 3½ | 7⅜ | 10¾ | ⅞ | 916 | 138.2 | 5 58 | 291 | 41.6 | 3 14 |
| | 3/8 | 1/2 | 13½ | " | 1⅛ | " | " | " | " | " | " | 1073 | 159.0 | 5 71 | 348 | 49 7 | 3 25 |
| | 7/16 | 1/2 | " | " | 1¼ | " | " | " | " | 10⅝ | " | 1136 | 168 3 | 5 68 | 368 | 52 6 | 3 23 |
| | 1/2 | 1/2 | " | " | 1⅜ | " | " | " | " | 10½ | " | 1197 | 177.4 | 5.65 | 388 | 55.4 | 3.22 |
| 12×1/2 | 6×4×1/2 | 14×1/2 | 13½ | 14 | 1½ | 7½ | 2½ | 3½ | 7½ | 10½ | ⅞ | 1215 | 180.0 | 5 58 | 394 | 56 3 | 3.18 |
| | 1/2 | 5/8 | 13¾ | " | 1½ | " | " | " | " | " | " | 1377 | 200 4 | 5 69 | 451 | 64 4 | 3 26 |
| | 9/16 | 5/8 | " | " | 1⅝ | " | " | " | " | 10⅜ | " | 1437 | 209 0 | 5 67 | 472 | 67 4 | 3 25 |
| | 5/8 | 5/8 | " | " | 1¾ | " | " | " | " | 10¼ | " | 1495 | 217 5 | 5 64 | 492 | 70 3 | 3 24 |
| 12×5/8 | 6×4×5/8 | 14×5/8 | 13¾ | 14 | 1⅞ | 7½ | 2½ | 3½ | 7⅝ | 10¼ | ⅞ | 1513 | 220.2 | 5 59 | 499 | 71 3 | 3.21 |
| | 5/8 | 3/4 | 14 | " | " | " | " | " | " | " | " | 1682 | 240 3 | 5 69 | 556 | 79.4 | 3 27 |
| | 5/8 | 7/8 | 14¼ | " | " | " | " | " | " | " | " | 1856 | 260 6 | 5 79 | 613 | 87 6 | 3 33 |
| | 5/8 | 1 | 14½ | " | " | " | " | " | " | " | " | 2035 | 280 7 | 5 88 | 671 | 95 8 | 3 37 |
| 12×3/4 | 6×4×3/4 | 14×3/4 | 14 | 14 | 2¼ | 7½ | 2½ | 3½ | 7¾ | 10 | ⅞ | 1808 | 258 3 | 5 60 | 609 | 87 0 | 3 25 |
| | 3/4 | 7/8 | 14¼ | " | " | " | " | " | " | " | " | 1982 | 278 2 | 5 69 | 666 | 95 1 | 3.30 |
| | 3/4 | 1 | 14½ | " | " | " | " | " | " | " | " | 2161 | 298 1 | 5 78 | 723 | 103 3 | 3 34 |
| | 6×4×7/8 | 14×7/8 | 14¼ | " | 2½ | " | " | " | " | 9¾ | " | 2085 | 292 6 | 5 64 | 710 | 101 4 | 3 29 |
| | 7/8 | 1 | 14½ | " | " | " | " | " | " | " | " | 2265 | 312 4 | 5 74 | 767 | 109 6 | 3.33 |
| 12×5/8 | 6×4×5/8 | 14×1⅛ | 14¾ | 14 | 1⅞ | 7½ | 2½ | 3½ | 7⅝ | 10¼ | ⅞ | 2224 | 303 0 | 5 97 | 728 | 104 0 | 3.41 |
| | 5/8 | 1¼ | 15 | " | " | " | " | " | " | " | " | 2418 | 322 4 | 6 06 | 785 | 112 1 | 3.45 |
| | 5/8 | 1⅜ | 15¼ | " | " | " | " | " | " | " | " | 2618 | 343 3 | 6 14 | 842 | 120 3 | 3.48 |
| | 5/8 | 1½ | 15½ | " | " | " | " | " | " | " | " | 2825 | 364.5 | 6.22 | 899 | 128.4 | 3.51 |
| | 6×4×5/8 | 14×1⅝ | 15¾ | 14 | 1⅞ | 7½ | 2½ | 3½ | 7⅝ | 10¼ | ⅞ | 3038 | 385 8 | 6 30 | 956 | 136.6 | 3.54 |
| | 5/8 | 1¾ | 16 | " | " | " | " | " | " | " | " | 3259 | 407 4 | 6 38 | 1014 | 144 8 | 3.56 |
| | 5/8 | 1⅞ | 16¼ | " | " | " | " | " | " | " | " | 3486 | 429 2 | 6 46 | 1071 | 153 0 | 3.58 |
| | 5/8 | 2 | 16½ | " | " | " | " | " | " | " | " | 3721 | 451 0 | 6.54 | 1128 | 161.1 | 3.60 |




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

12½"

Columns above heavy horizontal line have no metal above 1" thick.
Unequal Angles have short leg against web plate.
Dimensions *h*, *m*, *o*, and *g* can be varied considerably.

## ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14½" PLATE AND ANGLE COLUMNS

[For 14½" Columns with Cover Plates see following pages]

| 1 Web Plate | 4 Angles | Weight Per Foot | Area Sq. in. | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 |
| 14×¼ | 3½×3×¼ | 33 5 | 9 74 | 1 29 | 146 | 134 | 118 | 104 | 90 | 79 | 68 | 60 | ... | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 43 5 | 12 70 | 1 38 | 191 | 180 | 161 | 142 | 125 | 110 | 97 | 85 | ... | ... | ... | ... | ... | ... | ... | ... |
| | 4×3×¼ | 35 1 | 10 26 | 1 52 | 154 | 151 | 137 | 123 | 110 | 98 | 87 | 78 | 69 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 45 9 | 13 42 | 1 62 | 201 | 201 | 185 | 168 | 151 | 136 | 122 | 109 | 98 | ... | ... | ... | ... | ... | ... | ... |
| | 4×3½×3/8 | 48 3 | 14 18 | 1 59 | 213 | 212 | 194 | 175 | 157 | 141 | 126 | 113 | 101 | ... | ... | ... | ... | ... | ... | ... |
| | 5×3½×5/16 | 46 7 | 13 74 | 2 03 | 206 | 206 | 206 | 194 | 179 | 165 | 152 | 139 | 127 | 117 | 107 | 98 | 90 | ... | ... | ... |
| | 3/8 | 53 5 | 15 70 | 2 08 | 236 | 236 | 236 | 223 | 207 | 192 | 177 | 162 | 149 | 137 | 126 | 116 | 106 | ... | ... | ... |
| 14×5/16 | 4×3×5/16 | 43 7 | 12 74 | 1 54 | 191 | 189 | 171 | 154 | 138 | 123 | 110 | 98 | 87 | ... | ... | ... | ... | ... | ... | ... |
| | 3/8 | 48 9 | 14 30 | 1 59 | 215 | 214 | 195 | 177 | 159 | 142 | 127 | 114 | 102 | ... | ... | ... | ... | ... | ... | ... |
| | 4×3½×3/8 | 51 3 | 15 06 | 1 56 | 226 | 224 | 204 | 184 | 165 | 147 | 131 | 117 | 105 | ... | ... | ... | ... | ... | ... | ... |
| | 5×3½×5/16 | 49 7 | 14 62 | 1 98 | 219 | 219 | 219 | 204 | 188 | 173 | 158 | 145 | 132 | 121 | 111 | 101 | 93 | ... | ... | ... |
| | 3/8 | 56 5 | 16 58 | 2 04 | 249 | 249 | 249 | 234 | 217 | 201 | 184 | 169 | 155 | 142 | 130 | 119 | 109 | ... | ... | ... |
| | 6×4×3/8 | 64 1 | 18 82 | 2 50 | 282 | 282 | 282 | 282 | 271 | 255 | 239 | 224 | 209 | 195 | 182 | 169 | 157 | ... | ... | ... |
| | 7/16 | 72 1 | 21 10 | 2 55 | 317 | 317 | 317 | 317 | 306 | 291 | 272 | 254 | 238 | 222 | 207 | 193 | 180 | ... | ... | ... |
| 14×3/8 | 4×3×3/8 | 51 9 | 15 17 | 1 57 | 228 | 226 | 206 | 186 | 167 | 149 | 133 | 119 | 106 | ... | ... | ... | ... | ... | ... | ... |
| | 4×3½×3/8 | 54 3 | 15 93 | 1 54 | 239 | 236 | 214 | 193 | 173 | 154 | 137 | 122 | 109 | ... | ... | ... | ... | ... | ... | ... |
| | 5×3½×3/8 | 59 5 | 17 45 | 2 01 | 262 | 262 | 262 | 244 | 226 | 209 | 192 | 175 | 160 | 147 | 134 | 123 | 113 | ... | ... | ... |
| | 7/16 | 65 9 | 19 37 | 2 06 | 291 | 291 | 291 | 274 | 255 | 235 | 217 | 199 | 182 | 167 | 153 | 140 | 129 | ... | ... | ... |
| | ½ | 72 3 | 21 25 | 2 11 | 319 | 319 | 319 | 304 | 283 | 262 | 242 | 223 | 204 | 188 | 173 | 159 | 146 | ... | ... | ... |
| | 6×4×3/8 | 67 1 | 19 69 | 2 46 | 295 | 295 | 295 | 295 | 282 | 265 | 248 | 232 | 216 | 201 | 187 | 174 | 162 | 151 | 140 | ... |
| | 7/16 | 75 1 | 21 97 | 2 52 | 330 | 330 | 330 | 330 | 317 | 299 | 281 | 263 | 246 | 229 | 214 | 199 | 185 | 173 | 161 | ... |
| | ½ | 82 7 | 24 25 | 2 57 | 364 | 364 | 364 | 364 | 353 | 333 | 314 | 294 | 275 | 257 | 240 | 224 | 209 | 195 | 182 | ... |
| | 6×6×3/8 | 77 5 | 22 69 | 2 30 | 340 | 340 | 340 | 335 | 315 | 294 | 274 | 255 | 236 | 218 | 202 | 187 | 173 | 160 | ... | ... |
| | 7/16 | 86 7 | 25 49 | 2 34 | 382 | 382 | 382 | 379 | 357 | 334 | 311 | 290 | 269 | 249 | 231 | 214 | 198 | 184 | ... | ... |
| | ½ | 96 3 | 28 25 | 2 38 | 424 | 424 | 424 | 423 | 398 | 373 | 349 | 325 | 302 | 280 | 260 | 241 | 224 | 208 | ... | ... |
| 14×½ | 5×3½×½ | 78 2 | 23.00 | 2 07 | 345 | 345 | 345 | 326 | 303 | 280 | 258 | 237 | 218 | 199 | 183 | 168 | 155 | ... | ... | ... |
| | 5/8 | 91 0 | 26 68 | 2 15 | 400 | 400 | 400 | 384 | 358 | 333 | 308 | 284 | 261 | 241 | 221 | 204 | 188 | ... | ... | ... |
| | 6×4×½ | 88 6 | 26 00 | 2 52 | 390 | 390 | 390 | 390 | 375 | 354 | 332 | 311 | 291 | 271 | 253 | 235 | 219 | 204 | 191 | 178 |
| | 9/16 | 96 2 | 28 24 | 2 56 | 424 | 424 | 424 | 424 | 410 | 387 | 364 | 341 | 320 | 298 | 278 | 260 | 242 | 226 | 211 | 197 |
| | 5/8 | 103 8 | 30 44 | 2.60 | 457 | 457 | 457 | 457 | 445 | 420 | 396 | 372 | 348 | 326 | 304 | 284 | 265 | 248 | 231 | 216 |
| | 6×6×½ | 102 2 | 30 00 | 2.35 | 450 | 450 | 450 | 447 | 420 | 394 | 368 | 342 | 317 | 294 | 273 | 253 | 234 | 217 | ... | ... |
| | 9/16 | 111 4 | 32 72 | 2.39 | 491 | 491 | 491 | 490 | 462 | 434 | 405 | 378 | 351 | 326 | 303 | 281 | 260 | 242 | ... | ... |
| | 5/8 | 120 6 | 35 44 | 2.42 | 532 | 532 | 532 | 532 | 503 | 472 | 442 | 412 | 384 | 357 | 331 | 308 | 286 | 266 | ... | ... |
| 14×5/8 | 6×6×5/8 | 126 6 | 37 19 | 2.41 | 558 | 558 | 558 | 558 | 527 | 495 | 463 | 431 | 402 | 373 | 347 | 322 | 299 | 278 | ... | ... |
| | ¾ | 144 6 | 42 51 | 2 47 | 638 | 638 | 638 | 638 | 609 | 573 | 537 | 502 | 468 | 436 | 406 | 377 | 351 | 326 | ... | ... |
| 14×¾ | 6×6×¾ | 150 5 | 44 26 | 2.47 | 664 | 664 | 664 | 664 | 634 | 596 | 559 | 522 | 487 | 454 | 422 | 393 | 365 | 340 | ... | ... |
| | 7/8 | 168 1 | 49.42 | 2.53 | 741 | 741 | 741 | 741 | 714 | 674 | 633 | 593 | 554 | 517 | 482 | 449 | 419 | 390 | 364 | 340 |

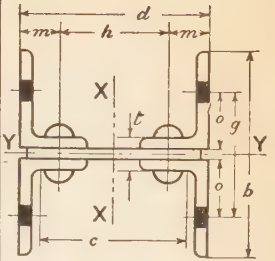
Unequal Angles have short leg against web plate.
Weights given do not include rivets or other details.
Loads to right of heavy vertical lines are for Secondary Members ONLY.

# DIMENSIONS AND FUNCTIONS OF 14½″ PLATE AND ANGLE COLUMNS

[For 14½″ Columns with Cover Plates see following pages]

| 1 Web Plate | 4 Angles | DIMENSIONS d | b | t | h | m | o | g | c | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14×¼ | 3½×3 ×¼ | 14½ | 7¼ | ¾ | 11 | 1¾ | 2 | 4¼ | 13¼ | ⅞ | 323 | 44.5 | 5.76 | 16 | 4.5 | 1.29 |
| | ⅜ | " | " | 1 | " | " | " | " | 13 | " | 444 | 61.2 | 5.91 | 24 | 6.7 | 1.38 |
| | 4 ×3 ×¼ | " | 8¼ | ¾ | " | " | 2½ | 5¼ | 13¼ | " | 349 | 44.7 | 5.83 | 24 | 5.8 | 1.52 |
| | ⅜ | " | " | 1 | " | " | " | " | 13 | " | 480 | 66.2 | 5.98 | 35 | 8.6 | 1.62 |
| | 4 ×3½×⅜ | 14½ | 8¼ | 1 | 10½ | 2 | 2½ | 5¼ | 13 | ⅞ | 492 | 67.8 | 5.89 | 36 | 8.7 | 1.59 |
| | 5 ×3½×5/16 | " | 10¼ | ⅞ | " | " | 3 | 6¼ | 13 | " | 489 | 67.5 | 5.97 | 57 | 11.0 | 2.03 |
| | ⅜ | " | " | 1 | " | " | " | " | 12⅞ | " | 568 | 78.4 | 6.02 | 68 | 13.2 | 2.08 |
| 14×5/16 | 4 ×3 ×5/16 | 14½ | 8 5/16 | 15/16 | 11 | 1¾ | 2½ | 5 5/16 | 13⅛ | ⅞ | 431 | 59.4 | 5.82 | 30 | 7.3 | 1.54 |
| | ⅜ | " | " | 1 1/16 | " | " | " | " | 13 | " | 495 | 68.2 | 5.88 | 36 | 8.7 | 1.59 |
| | 4 ×3½×⅜ | " | " | " | 10½ | 2 | " | " | 13 | " | 506 | 69.8 | 5.79 | 37 | 8.8 | 1.56 |
| | 5 ×3½×5/16 | 14½ | 10 5/16 | 15/16 | 10½ | 2 | 3 | 6 5/16 | 13 | ⅞ | 504 | 69.5 | 5.87 | 58 | 11.2 | 1.98 |
| | ⅜ | " | " | 1 1/16 | " | " | " | " | 12⅞ | " | 583 | 80.4 | 5.93 | 69 | 13.4 | 2.04 |
| | 6 ×4 ×⅜ | " | 12 5/16 | " | 9½ | 2½ | 3½ | 7 5/16 | 12¾ | " | 667 | 92.0 | 5.95 | 117 | 19.0 | 2.50 |
| | 7/16 | " | " | 1 3/16 | " | " | " | " | 12⅝ | " | 756 | 104.2 | 5.98 | 137 | 22.2 | 2.55 |
| 14×⅜ | 4 ×3 ×⅜ | 14½ | 8⅜ | 1⅛ | 11 | 1¾ | 2½ | 5⅜ | 13 | ⅞ | 509 | 70.2 | 5.79 | 37 | 8.9 | 1.57 |
| | 4 ×3½×⅜ | " | " | " | 10½ | 2 | " | " | 13 | " | 520 | 71.8 | 5.72 | 38 | 9.0 | 1.54 |
| | 5 ×3½×⅜ | " | 10⅜ | " | " | " | 3 | 6⅜ | 12⅞ | " | 597 | 82.3 | 5.85 | 71 | 13.6 | 2.01 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 12¾ | " | 673 | 92.8 | 5.89 | 82 | 15.9 | 2.06 |
| | ½ | " | " | 1⅜ | " | " | " | " | 12⅝ | " | 745 | 102.7 | 5.92 | 95 | 18.3 | 2.11 |
| | 6 ×4 ×⅜ | 14½ | 12⅜ | 1⅛ | 9½ | 2½ | 3½ | 7⅜ | 12¾ | ⅞ | 681 | 94.0 | 5.88 | 119 | 19.3 | 2.46 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 12⅝ | " | 770 | 106.2 | 5.92 | 139 | 22.5 | 2.52 |
| | ½ | " | " | 1⅜ | " | " | " | " | 12½ | " | 856 | 117.7 | 5.94 | 160 | 25.8 | 2.57 |
| | 6 ×6 ×⅜ | " | " | 1⅛ | 7½ | 3½ | " | " | 12¾ | " | 696 | 95.9 | 5.53 | 120 | 19.4 | 2.30 |
| | 7/16 | " | " | 1¼ | " | " | " | " | 12⅝ | " | 789 | 108.8 | 5.56 | 140 | 22.6 | 2.34 |
| | ½ | " | " | 1⅜ | " | " | " | " | 12½ | " | 879 | 121.2 | 5.58 | 160 | 25.8 | 2.38 |
| 14×½ | 5 ×3½×½ | 14½ | 10½ | 1½ | 10½ | 2 | 3 | 6½ | 12⅝ | ⅞ | 773 | 106.6 | 5.80 | 99 | 18.8 | 2.07 |
| | 5/8 | " | " | 1¾ | " | " | " | " | 12⅜ | " | 914 | 126.1 | 5.86 | 123 | 23.5 | 2.15 |
| | 6 ×4 ×½ | " | 12½ | 1½ | 9½ | 2½ | 3½ | 7½ | 12½ | " | 884 | 122.0 | 5.83 | 165 | 26.4 | 2.52 |
| | 9/16 | " | " | 1⅝ | " | " | " | " | 12⅜ | " | 969 | 133.6 | 5.86 | 186 | 29.7 | 2.56 |
| | 5/8 | " | " | 1¾ | " | " | " | " | 12¼ | " | 1051 | 145.0 | 5.88 | 206 | 33.0 | 2.60 |
| | 6 ×6 ×½ | 14½ | 12½ | 1½ | 7½ | 3½ | 3½ | 7½ | 12½ | ⅞ | 907 | 125.1 | 5.50 | 166 | 26.5 | 2.35 |
| | 9/16 | " | " | 1⅝ | " | " | " | " | 12⅜ | " | 992 | 136.8 | 5.51 | 187 | 30.0 | 2.39 |
| | 5/8 | " | " | 1¾ | " | " | " | " | 12¼ | " | 1077 | 148.6 | 5.52 | 208 | 33.3 | 2.42 |
| 14×⅝ | 6 ×6 ×⅝ | 14½ | 12⅝ | 1⅞ | 7½ | 3½ | 3½ | 7⅝ | 12¼ | ⅞ | 1106 | 152.6 | 5.46 | 216 | 34.1 | 2.41 |
| | ¾ | " | " | 2⅛ | " | " | " | " | 12 | " | 1266 | 174.7 | 5.46 | 261 | 41.2 | 2.47 |
| 14×¾ | 6 ×6 ×¾ | 14½ | 12¾ | 2¼ | 7½ | 3½ | 3½ | 7¾ | 12 | ⅞ | 1295 | 178.5 | 5.41 | 270 | 42.3 | 2.47 |
| | ⅞ | " | " | 2½ | " | " | " | " | 11¾ | " | 1447 | 199.6 | 5.41 | 316 | 49.5 | 2.53 |

Unequal Angles have short leg against web plate.
Dimensions *h*, *m*, *o*, and *g* can be varied considerably.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration

## ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 14½" PLATE AND ANGLE COLUMNS WITH COVER PLATES

| 1 Web Plate | 4 Angles | 2 Cover Plates | Weight Per Foot | Area Sq. In. | Least Radius Gyr. | Unsupported Length In Feet | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 44 |
| 14×3/8 | 6×4×3/8 | 14× 3/8 | 102.8 | 30.19 | 3.10 | 453 | 453 | 448 | 428 | 408 | 387 | 367 | 348 | 329 | 311 | 293 | 277 | 261 | 247 | .... | .... |
| | 7/16 | 3/8 | 110.8 | 32.47 | 3.09 | 487 | 487 | 481 | 460 | 438 | 416 | 394 | 373 | 353 | 333 | 314 | 297 | 280 | 264 | .... | .... |
| | 1/2 | 3/8 | 118.4 | 34.75 | 3.09 | 521 | 521 | 515 | 492 | 468 | 445 | 422 | 399 | 377 | 357 | 336 | 318 | 300 | 283 | .... | .... |
| | 1/2 | 7/16 | 124.3 | 36.50 | 3.14 | 548 | 548 | 544 | 520 | 496 | 472 | 448 | 424 | 402 | 380 | 359 | 339 | 320 | 303 | .... | .... |
| | 1/2 | 1/2 | 130.3 | 38.25 | 3.19 | 574 | 574 | 573 | 549 | 524 | 499 | 474 | 449 | 426 | 403 | 381 | 361 | 341 | 322 | 305 | .... |
| | 1/2 | 9/16 | 136.2 | 40.00 | 3.23 | 600 | 600 | 600 | 577 | 551 | 525 | 500 | 474 | 450 | 426 | 403 | 382 | 361 | 342 | 323 | .... |
| | 1/2 | 5/8 | 142.2 | 41.75 | 3.27 | 626 | 626 | 626 | 605 | 578 | 552 | 525 | 499 | 474 | 449 | 425 | 403 | 382 | 361 | 342 | .... |
| 14×1/2 | 6×4×1/2 | 14× 5/8 | 148.1 | 43.50 | 3.22 | 653 | 653 | 653 | 626 | 598 | 570 | 542 | 515 | 488 | 462 | 437 | 414 | 392 | 370 | 350 | .... |
| | 9/16 | 5/8 | 155.7 | 45.74 | 3.21 | 686 | 686 | 686 | 658 | 628 | 598 | 569 | 540 | 512 | 484 | 458 | 434 | 410 | 388 | 367 | .... |
| | 5/8 | 5/8 | 163.3 | 47.94 | 3.20 | 719 | 719 | 719 | 688 | 657 | 626 | 595 | 565 | 535 | 507 | 479 | 454 | 429 | 406 | 384 | .... |
| 14×5/8 | 6×4×5/8 | 14× 5/8 | 169.3 | 49.69 | 3.17 | 745 | 745 | 743 | 711 | 678 | 645 | 613 | 581 | 551 | 521 | 492 | 466 | 440 | 416 | .... | .... |
| | 5/8 | 3/4 | 181.2 | 53.19 | 3.23 | 798 | 798 | 798 | 767 | 732 | 698 | 664 | 631 | 598 | 566 | 536 | 507 | 480 | 454 | 430 | .... |
| | 5/8 | 7/8 | 193.2 | 56.69 | 3.29 | 850 | 850 | 850 | 823 | 787 | 751 | 716 | 680 | 646 | 613 | 581 | 550 | 521 | 494 | 467 | .... |
| | 5/8 | 1 | 205.0 | 60.19 | 3.34 | 903 | 903 | 903 | 879 | 842 | 804 | 767 | 729 | 693 | 658 | 625 | 592 | 562 | 532 | 504 | .... |
| 14×3/4 | 6×6×3/4 | 14× 3/4 | 221.9 | 65.26 | 3.06 | 979 | 979 | 964 | 920 | 876 | 831 | 787 | 745 | 703 | 664 | 626 | 591 | 557 | 525 | .... | .... |
| | 3/4 | 7/8 | 233.9 | 68.76 | 3.12 | 1031 | 1031 | 1022 | 978 | 932 | 885 | 840 | 796 | 752 | 711 | 672 | 635 | 599 | 566 | .... | .... |
| | 3/4 | 1 | 245.7 | 72.26 | 3.17 | 1084 | 1084 | 1080 | 1034 | 986 | 939 | 892 | 845 | 801 | 757 | 716 | 677 | 640 | 606 | .... | .... |
| 14×3/4 | 6×6×7/8 | 16× 7/8 | 263.3 | 77.42 | 3.43 | 1161 | 1161 | 1161 | 1142 | 1095 | 1048 | 1001 | 955 | 909 | 865 | 821 | 780 | 741 | 702 | 667 | 602 |
| | 7/8 | 1 | 276.9 | 81.42 | 3.50 | 1221 | 1221 | 1221 | 1210 | 1162 | 1114 | 1065 | 1017 | 970 | 923 | 879 | 835 | 794 | 754 | 716 | 647 |
| 14×5/8 | 6×4×5/8 | 14×1 1/8 | 216.9 | 63.69 | 3.38 | 955 | 955 | 955 | 934 | 895 | 856 | 817 | 778 | 741 | 703 | 667 | 634 | 601 | 570 | 541 | .... |
| | 5/8 | 1 1/4 | 228.8 | 67.19 | 3.42 | 1008 | 1008 | 1008 | 990 | 949 | 908 | 867 | 827 | 787 | 748 | 711 | 675 | 641 | 608 | 577 | 520 |
| | 5/8 | 1 3/8 | 240.6 | 70.69 | 3.45 | 1060 | 1060 | 1060 | 1045 | 1002 | 960 | 917 | 874 | 833 | 792 | 754 | 716 | 680 | 645 | 613 | 553 |
| | 5/8 | 1½ | 252.6 | 74.19 | 3.48 | 1113 | 1113 | 1113 | 1100 | 1056 | 1012 | 967 | 924 | 880 | 838 | 797 | 757 | 720 | 683 | 649 | 586 |
| | 5/8 | 1 5/8 | 264.6 | 77.69 | 3.51 | 1165 | 1165 | 1165 | 1155 | 1109 | 1064 | 1018 | 972 | 927 | 883 | 840 | 799 | 759 | 722 | 685 | 620 |
| | 5/8 | 1 3/4 | 276.6 | 81.19 | 3.53 | 1218 | 1218 | 1218 | 1209 | 1163 | 1115 | 1067 | 1019 | 973 | 926 | 882 | 839 | 798 | 758 | 721 | 652 |
| | 5/8 | 1 7/8 | 288.3 | 84.69 | 3.56 | 1270 | 1270 | 1270 | 1265 | 1217 | 1168 | 1118 | 1069 | 1020 | 971 | 926 | 881 | 838 | 798 | 758 | 686 |
| | 5/8 | 2 | 300.2 | 88.19 | 3.58 | 1323 | 1323 | 1323 | 1320 | 1270 | 1219 | 1168 | 1116 | 1066 | 1017 | 969 | 923 | 877 | 835 | 794 | 719 |
| 14×5/8 | 6×4×5/8 | 16×1 7/8 | 313.8 | 92.19 | 4.02 | 1383 | 1383 | 1383 | 1383 | 1383 | 1340 | 1291 | 1244 | 1196 | 1148 | 1102 | 1056 | 1010 | 968 | 926 | 847 |
| | 5/8 | 2 | 327.4 | 96.19 | 4.05 | 1443 | 1443 | 1443 | 1443 | 1443 | 1401 | 1351 | 1302 | 1252 | 1203 | 1154 | 1107 | 1061 | 1016 | 972 | 891 |
| 14×5/8 | 6×6×5/8 | 16×2 | 344.2 | 101.19 | 3.95 | 1518 | 1518 | 1518 | 1518 | 1512 | 1459 | 1407 | 1353 | 1299 | 1247 | 1194 | 1143 | 1094 | 1046 | 1001 | 914 |
| | 5/8 | 2 1/8 | 357.8 | 105.19 | 3.98 | 1578 | 1578 | 1578 | 1578 | 1575 | 1521 | 1466 | 1411 | 1356 | 1302 | 1249 | 1195 | 1144 | 1095 | 1048 | 957 |
| | 5/8 | 2 1/4 | 371.4 | 109.19 | 4.01 | 1638 | 1638 | 1638 | 1638 | 1638 | 1584 | 1528 | 1471 | 1414 | 1357 | 1303 | 1248 | 1195 | 1144 | 1094 | 1001 |
| | 5/8 | 2 3/8 | 385.0 | 113.19 | 4.03 | 1698 | 1698 | 1698 | 1698 | 1698 | 1647 | 1587 | 1528 | 1470 | 1412 | 1355 | 1298 | 1244 | 1191 | 1140 | 1042 |
| | 5/8 | 2½ | 398.6 | 117.19 | 4.05 | 1758 | 1758 | 1758 | 1758 | 1758 | 1706 | 1647 | 1587 | 1526 | 1466 | 1406 | 1349 | 1293 | 1238 | 1185 | 1085 |

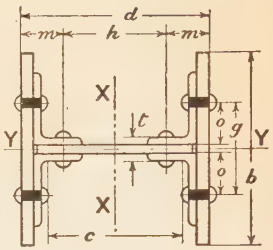
Columns above heavy horizontal line have no metal above 1" thick.
Unequal angles have short leg against web plate.
Weights given do not include rivets or other details.
Loads to right of heavy vertical lines are for secondary members ONLY.

LOADS BY A. I. S. C. SPECIFICATION

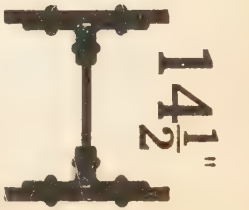
# DIMENSIONS AND FUNCTIONS OF 14½" PLATE AND ANGLE COLUMNS WITH COVER PLATES

| 1 Web Plate | 4 Angles | 2 Cover Plates | DIMENSIONS d | b | t | h | m | o | g | c | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6×4×3/8 | 14×3/8 | 15¼ | 14 | 1⅛ | 9½ | 2½ | 3½ | 7⅜ | 12¾ | ⅞ | 1262 | 166 | 6.46 | 291 | 41.6 | 3.10 |
| | 7/16 | 3/8 | " | " | 1¼ | " | " | " | " | 12⅝ | " | 1351 | 177 | 6.45 | 311 | 44.4 | 3.09 |
| | ½ | 3/8 | " | " | 1⅜ | " | " | " | " | 12½ | " | 1437 | 189 | 6.42 | 331 | 47.3 | 3.09 |
| 14×3/8 | ½ | 7/16 | 15⅜ | " | " | " | " | " | " | " | " | 1539 | 200 | 6.50 | 360 | 51.4 | 3.14 |
| | ½ | ½ | 15½ | 14 | 1⅜ | 9½ | 2½ | 3½ | 7⅜ | 12½ | ⅞ | 1644 | 212 | 6.56 | 389 | 55.6 | 3.19 |
| | ½ | 9/16 | 15⅝ | " | " | " | " | " | " | " | " | 1749 | 224 | 6.61 | 417 | 59.6 | 3.23 |
| | ½ | 5/8 | 15¾ | " | " | " | " | " | " | " | " | 1857 | 236 | 6.67 | 446 | 63.7 | 3.27 |
| | 6×4×½ | 14×5/8 | 15¾ | 14 | 1½ | 9½ | 2½ | 3½ | 7½ | 12½ | ⅞ | 1885 | 240 | 6.58 | 451 | 64.4 | 3.22 |
| 14×½ | 9/16 | 5/8 | " | " | 1⅝ | " | " | " | " | 12⅜ | " | 1970 | 250 | 6.56 | 472 | 67.4 | 3.21 |
| | 5/8 | 5/8 | " | " | 1¾ | " | " | " | " | 12¼ | " | 2053 | 261 | 6.54 | 492 | 70.3 | 3.20 |
| | 6×4×5/8 | 14×5/8 | 15¾ | 14 | 1⅞ | 9½ | 2½ | 3½ | 7⅝ | 12¼ | ⅞ | 2081 | 265 | 6.47 | 499 | 71.3 | 3.17 |
| | 5/8 | ¾ | 16 | " | " | " | " | " | " | " | " | 2302 | 288 | 6.58 | 556 | 79.4 | 3.23 |
| 14×5/8 | 5/8 | ⅞ | 16¼ | " | " | " | " | " | " | " | " | 2529 | 311 | 6.68 | 613 | 87.6 | 3.29 |
| | 5/8 | 1 | 16½ | " | " | " | " | " | " | " | " | 2762 | 335 | 6.78 | 671 | 95.8 | 3.34 |
| | 6×6×¾ | 14×¾ | 16 | 14 | 2¼ | 7½ | 3½ | 3½ | 7¾ | 12 | ⅞ | 2517 | 315 | 6.21 | 613 | 87.6 | 3.06 |
| 14×¾ | ¾ | ⅞ | 16¼ | " | " | " | " | " | " | " | " | 2741 | 338 | 6.32 | 670 | 95.7 | 3.12 |
| | ¾ | 1 | 16½ | " | " | " | " | " | " | " | " | 2977 | 361 | 6.42 | 727 | 103.8 | 3.17 |
| 14×¾ | 6×6×⅞ | 16×⅞ | 16¼ | 16 | 2½ | 7½ | 3½ | 3½ | 7¾ | 11¾ | ⅞ | 3103 | 382 | 6.33 | 913 | 114.1 | 3.43 |
| | ⅞ | 1 | 16½ | " | " | " | " | " | " | " | " | 3371 | 409 | 6.43 | 998 | 124.8 | 3.50 |
| | 6×4×5/8 | 14×1⅛ | 16¾ | 14 | 1⅞ | 9½ | 2½ | 3½ | 7⅝ | 12¼ | ⅞ | 3006 | 359 | 6.87 | 728 | 104.0 | 3.38 |
| | 5/8 | 1¼ | 17 | " | " | " | " | " | " | " | " | 3255 | 383 | 6.96 | 785 | 112.1 | 3.42 |
| | 5/8 | 1⅜ | 17¼ | " | " | " | " | " | " | " | " | 3512 | 408 | 7.05 | 842 | 120.3 | 3.45 |
| | 5/8 | 1½ | 17½ | " | " | " | " | " | " | " | " | 3776 | 432 | 7.13 | 899 | 128.4 | 3.48 |
| 14×5/8 | 5/8 | 1⅝ | 17¾ | 14 | 1⅞ | 9½ | 2½ | 3½ | 7⅝ | 12¼ | ⅞ | 4048 | 456 | 7.22 | 956 | 136.5 | 3.51 |
| | 5/8 | 1¾ | 18 | " | " | " | " | " | " | " | " | 4327 | 481 | 7.30 | 1014 | 144.8 | 3.53 |
| | 5/8 | 1⅞ | 18¼ | " | " | " | " | " | " | " | " | 4615 | 506 | 7.38 | 1071 | 153.0 | 3.56 |
| | 5/8 | 2 | 18½ | " | " | " | " | " | " | " | " | 4910 | 531 | 7.46 | 1128 | 161.1 | 3.58 |
| 14×5/8 | 6×4×5/8 | 16×1⅞ | 18¼ | 16 | 1⅞ | 9½ | 2½ | 3½ | 7⅝ | 12¼ | ⅞ | 5120 | 561 | 7.45 | 1493 | 186.6 | 4.02 |
| | 5/8 | 2 | 18½ | " | " | " | " | " | " | " | " | 5457 | 590 | 7.53 | 1579 | 197.4 | 4.05 |
| | 6×6×5/8 | 16×2 | 18½ | 16 | 1⅞ | 7½ | 3½ | 3½ | 7⅝ | 12¼ | ⅞ | 5484 | 593 | 7.36 | 1581 | 197.6 | 3.95 |
| | 5/8 | 2⅛ | 18¾ | " | " | " | " | " | " | " | " | 5830 | 622 | 7.44 | 1666 | 208.2 | 3.98 |
| 14×5/8 | 5/8 | 2¼ | 19 | " | " | " | " | " | " | " | " | 6187 | 651 | 7.53 | 1752 | 219.0 | 4.01 |
| | 5/8 | 2⅜ | 19¼ | " | " | " | " | " | " | " | " | 6552 | 681 | 7.61 | 1837 | 229.6 | 4.03 |
| | 5/8 | 2½ | 19½ | " | " | " | " | " | " | " | " | 6928 | 711 | 7.69 | 1922 | 240.2 | 4.05 |

Sections above heavy horizontal line have no metal above 1" thick.
Unequal angles have short leg against web plate.
Dimensions *h*, *m*, *o* and *g* can be varied considerably.




I. is Moment of Inertia
S. is Section Modulus
r. is Radius of Gyration



# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 10″ CHANNEL COLUMNS WITH COVER PLATES

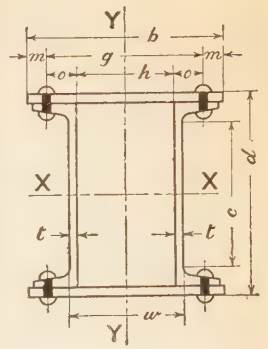
| 2 Channels | 2 Cover Plates | Weight Per Foot | Area Sq. Inches | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 |
| 10″ × 15.3# | 12 × 1/4 | 51 0 | 14.19 | 3.62 | 213 | 213 | 213 | 205 | 197 | 189 | 181 | 173 | 165 | 157 | 150 | 143 | 136 | 129 |
| | 5/16 | 56 1 | 16 44 | 3 60 | 247 | 247 | 247 | 237 | 228 | 218 | 209 | 199 | 190 | 181 | 173 | 164 | 157 | 149 |
| | 3/8 | 61 2 | 17 94 | 3.59 | 269 | 269 | 269 | 259 | 248 | 238 | 228 | 217 | 207 | 197 | 188 | 179 | 170 | 162 |
| | 7/16 | 66 3 | 19 44 | 3.58 | 292 | 292 | 291 | 280 | 269 | 257 | 246 | 235 | 224 | 214 | 203 | 193 | 184 | 175 |
| | 1/2 | 71 4 | 20 94 | 3 57 | 314 | 314 | 313 | 301 | 289 | 277 | 265 | 253 | 241 | 230 | 218 | 208 | 198 | 188 |
| 10″ × 20.0# | 12 × 1/4 | 60 4 | 16 97 | 3 53 | 255 | 255 | 253 | 243 | 233 | 223 | 213 | 203 | 194 | 184 | 175 | 167 | 159 | 151 |
| | 5/16 | 65 5 | 19 22 | 3 52 | 288 | 288 | 286 | 275 | 264 | 252 | 241 | 230 | 219 | 208 | 198 | 188 | 179 | 170 |
| | 3/8 | 70 6 | 20.72 | 3 51 | 311 | 311 | 308 | 296 | 284 | 271 | 259 | 247 | 235 | 224 | 213 | 202 | 192 | 183 |
| | 7/16 | 75 7 | 22 22 | 3.51 | 333 | 333 | 330 | 317 | 304 | 291 | 278 | 265 | 252 | 240 | 228 | 217 | 206 | 196 |
| | 1/2 | 80 8 | 23 72 | 3 51 | 356 | 356 | 353 | 339 | 325 | 311 | 297 | 283 | 269 | 256 | 244 | 232 | 220 | 209 |
| 10″ × 25.0# | 12 × 1/4 | 70 4 | 19 91 | 3 45 | 299 | 299 | 294 | 282 | 270 | 258 | 246 | 235 | 223 | 212 | 202 | 192 | 182 | 173 |
| | 5/16 | 75 5 | 22 16 | 3.45 | 332 | 332 | 328 | 314 | 301 | 287 | 274 | 261 | 248 | 236 | 225 | 213 | 202 | 192 |
| | 3/8 | 80 6 | 23 66 | 3.45 | 355 | 355 | 350 | 336 | 321 | 307 | 293 | 279 | 265 | 252 | 240 | 228 | 216 | 205 |
| | 1/2 | 90 8 | 26 66 | 3.45 | 400 | 400 | 394 | 378 | 362 | 346 | 330 | 314 | 299 | 284 | 270 | 257 | 243 | 231 |
| | 5/8 | 101 0 | 29 66 | 3 45 | 445 | 445 | 438 | 421 | 403 | 385 | 367 | 349 | 333 | 316 | 301 | 285 | 271 | 257 |
| 10″ × 30.0# | 12 × 1/4 | 80 4 | 22 85 | 3.33 | 343 | 343 | 333 | 319 | 305 | 290 | 276 | 263 | 249 | 237 | 224 | 213 | 201 | 191 |
| | 5/16 | 85 5 | 25.10 | 3.34 | 377 | 377 | 367 | 351 | 335 | 320 | 304 | 289 | 275 | 261 | 250 | 234 | 222 | 210 |
| | 3/8 | 90.6 | 26.60 | 3.35 | 399 | 399 | 389 | 373 | 356 | 339 | 323 | 307 | 292 | 277 | 265 | 249 | 236 | 224 |
| | 12 × 1/2 | 100 8 | 29.60 | 3.36 | 444 | 444 | 433 | 415 | 397 | 378 | 360 | 343 | 325 | 309 | 293 | 278 | 263 | 250 |
| | 5/8 | 111 0 | 32 60 | 3.37 | 489 | 489 | 478 | 458 | 438 | 418 | 398 | 378 | 359 | 341 | 323 | 307 | 291 | 276 |
| | 3/4 | 121 2 | 35 60 | 3.38 | 534 | 534 | 522 | 501 | 479 | 457 | 435 | 414 | 393 | 373 | 354 | 336 | 319 | 302 |
| 10″ × 35.0# | 12 × 1/4 | 90 4 | 25 79 | 3 25 | 387 | 387 | 373 | 356 | 340 | 323 | 307 | 291 | 276 | 261 | 247 | 234 | 222 | 210 |
| | 5/16 | 95 5 | 28 04 | 3 27 | 421 | 421 | 406 | 389 | 370 | 353 | 335 | 318 | 302 | 286 | 271 | 256 | 243 | 230 |
| | 3/8 | 100.6 | 29.54 | 3.28 | 443 | 443 | 429 | 410 | 391 | 372 | 354 | 336 | 318 | 302 | 286 | 271 | 256 | 243 |
| | 12 × 1/2 | 110 8 | 32 54 | 3.30 | 488 | 488 | 473 | 453 | 432 | 412 | 392 | 372 | 353 | 334 | 317 | 300 | 284 | 269 |
| | 5/8 | 121.0 | 35 54 | 3.31 | 533 | 533 | 518 | 495 | 473 | 450 | 428 | 407 | 386 | 366 | 347 | 329 | 311 | 295 |
| | 3/4 | 131 2 | 38.54 | 3.33 | 578 | 578 | 562 | 539 | 514 | 490 | 466 | 443 | 421 | 399 | 378 | 358 | 340 | 322 |

The 1/4″ Plates are tabulated with all weights of Channels, as adding some sectional area, without costing appreciably more than lattice bars and batten plates; 87 1/2 % of their area is included in the functions and column areas.
Weights given do not include rivets or other details.
Loads to right of heavy vertical lines are for secondary members ONLY.

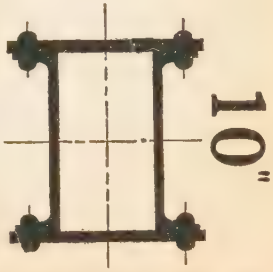
# DIMENSIONS AND FUNCTIONS OF 10″ CHANNEL COLUMNS WITH COVER PLATES

| 2 Channels | 2 Cover Plates | DIMENSIONS d | b | w | c | g | m | h | o | t | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10″ × 15.3# | 12 × 1/4 | 10 1/2 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 6 | 1 1/2 | .240 | 3/4 | 272 | 51.8 | 4.38 | 186 | 31.0 | 3.62 |
| | 5/16 | 10 5/8 | " | " | " | " | " | " | " | " | " | 333 | 62.7 | 4.50 | 213 | 35.5 | 3.60 |
| | 3/8 | 10 3/4 | " | " | " | " | " | " | " | " | " | 376 | 70.0 | 4.58 | 231 | 38.5 | 3.59 |
| | 7/16 | 10 7/8 | " | " | " | " | " | " | " | " | " | 420 | 77.2 | 4.65 | 249 | 41.5 | 3.58 |
| | 1/2 | 11 | " | " | " | " | " | " | " | " | " | 465 | 84.5 | 4.71 | 267 | 44.5 | 3.57 |
| 10″ × 20.0# | 12 × 1/4 | 10 1/2 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 5 3/4 | 1 5/8 | .379 | 3/4 | 295 | 56.2 | 4.17 | 211 | 35.2 | 3.53 |
| | 5/16 | 10 5/8 | " | " | " | " | " | " | " | " | " | 356 | 67.1 | 4.31 | 238 | 39.7 | 3.52 |
| | 3/8 | 10 3/4 | " | " | " | " | " | " | " | " | " | 399 | 74.3 | 4.39 | 256 | 42.7 | 3.51 |
| | 7/16 | 10 7/8 | " | " | " | " | " | " | " | " | " | 443 | 81.5 | 4.46 | 274 | 45.7 | 3.51 |
| | 1/2 | 11 | " | " | " | " | " | " | " | " | " | 488 | 88.7 | 4.53 | 292 | 48.7 | 3.51 |
| 10″ × 25.0# | 12 × 1/4 | 10 1/2 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 5 1/2 | 1 3/4 | .526 | 3/4 | 319 | 60.8 | 4.00 | 236 | 39.4 | 3.45 |
| | 5/16 | 10 5/8 | " | " | " | " | " | " | " | " | " | 381 | 71.7 | 4.15 | 263 | 43.9 | 3.45 |
| | 3/8 | 10 3/4 | " | " | " | " | " | " | " | " | " | 424 | 78.8 | 4.23 | 281 | 46.9 | 3.45 |
| | 1/2 | 11 | " | " | " | " | " | " | " | " | " | 512 | 93.1 | 4.38 | 317 | 52.9 | 3.45 |
| | 5/8 | 11 1/4 | " | " | " | " | " | " | " | " | " | 605 | 107.5 | 4.52 | 353 | 58.9 | 3.45 |
| 10″ × 30.0# | 12 × 1/4 | 10 1/2 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 5 1/8 | 1 15/16 | .673 | 3/4 | 344 | 65.5 | 3.88 | 253 | 42.1 | 3.33 |
| | 5/16 | 10 5/8 | " | " | " | " | " | " | " | " | " | 405 | 76.3 | 4.02 | 280 | 46.6 | 3.34 |
| | 3/8 | 10 3/4 | " | " | " | " | " | " | " | " | " | 448 | 83.4 | 4.10 | 298 | 49.6 | 3.35 |
| | 12 × 1/2 | 11 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 5 1/8 | 1 15/16 | .673 | 3/4 | 537 | 97.6 | 4.26 | 334 | 55.6 | 3.36 |
| | 5/8 | 11 1/4 | " | " | " | " | " | " | " | " | " | 629 | 111.9 | 4.39 | 370 | 61.6 | 3.37 |
| | 3/4 | 11 1/2 | " | " | " | " | " | " | " | " | " | 726 | 126.3 | 4.52 | 406 | 67.6 | 3.38 |
| 10″ × 35.0# | 12 × 1/4 | 10 1/2 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 4 7/8 | 2 1/16 | .820 | 3/4 | 368 | 70.2 | 3.78 | 275 | 45.9 | 3.25 |
| | 5/16 | 10 5/8 | " | " | " | " | " | " | " | " | " | 430 | 80.9 | 3.92 | 300 | 50.0 | 3.27 |
| | 3/8 | 10 3/4 | " | " | " | " | " | " | " | " | " | 473 | 87.9 | 4.00 | 318 | 53.0 | 3.28 |
| | 12 × 1/2 | 11 | 12 | 6 1/2 | 8 3/16 | 9 | 1 1/2 | 4 7/8 | 2 1/16 | .820 | 3/4 | 561 | 102.0 | 4.15 | 354 | 59.0 | 3.30 |
| | 5/8 | 11 1/4 | " | " | " | " | " | " | " | " | " | 654 | 116.2 | 4.29 | 390 | 65.0 | 3.31 |
| | 3/4 | 11 1/2 | " | " | " | " | " | " | " | " | " | 751 | 130.6 | 4.41 | 426 | 71.0 | 3.33 |

.875 of 12″ × 1/4″ plates used in areas and functions.




I. is Moment of Inertia.
S. is Section Modulus.
r. is Radius of Gyration.



# ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 12″ CHANNEL COLUMNS WITH COVER PLATES

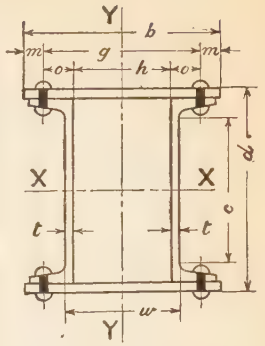
| 2 Channels | 2 Cover Plates | Weight Per Foot | Area Sq. Inches | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 |
| 12″ × 20.7# | 14 × 1/4 | 65.2 | 17.31 | 4.38 | 260 | 260 | 259 | 251 | 243 | 235 | 227 | 218 | 210 | 202 | 195 | 187 | 180 | 172 |
| | 5/16 | 71.2 | 20.81 | 4.33 | 312 | 312 | 310 | 301 | 291 | 281 | 271 | 261 | 251 | 241 | 232 | 223 | 214 | 205 |
| | 3/8 | 77.1 | 22.56 | 4.30 | 338 | 338 | 336 | 325 | 314 | 303 | 292 | 281 | 271 | 260 | 250 | 240 | 230 | 221 |
| | 14 × 7/16 | 83.1 | 24.31 | 4.29 | 365 | 365 | 361 | 350 | 338 | 326 | 315 | 303 | 291 | 280 | 269 | 258 | 248 | 238 |
| | 1/2 | 89.0 | 26.06 | 4.27 | 391 | 391 | 387 | 374 | 362 | 349 | 336 | 324 | 311 | 299 | 287 | 275 | 264 | 253 |
| | 5/8 | 100.9 | 29.56 | 4.24 | 443 | 443 | 438 | 424 | 409 | 394 | 380 | 366 | 351 | 338 | 324 | 311 | 298 | 286 |
| 12″ × 25.0# | 14 × 1/4 | 73.8 | 19.89 | 4.29 | 298 | 298 | 296 | 286 | 277 | 267 | 257 | 248 | 238 | 229 | 220 | 211 | 203 | 194 |
| | 5/16 | 79.8 | 23.39 | 4.25 | 351 | 351 | 347 | 335 | 324 | 312 | 301 | 290 | 279 | 268 | 257 | 246 | 236 | 226 |
| | 3/8 | 85.7 | 25.14 | 4.24 | 377 | 377 | 372 | 360 | 348 | 335 | 323 | 311 | 299 | 287 | 276 | 265 | 253 | 243 |
| | 14 × 7/16 | 91.7 | 26.89 | 4.23 | 404 | 404 | 398 | 385 | 372 | 358 | 345 | 332 | 319 | 307 | 294 | 282 | 271 | 259 |
| | 1/2 | 97.6 | 28.64 | 4.22 | 430 | 430 | 423 | 410 | 396 | 381 | 367 | 353 | 339 | 326 | 313 | 300 | 288 | 276 |
| | 5/8 | 109.5 | 32.14 | 4.20 | 482 | 482 | 474 | 459 | 443 | 427 | 411 | 395 | 380 | 365 | 350 | 335 | 321 | 308 |
| 12″ × 30.0# | 14 × 1/4 | 83.8 | 22.83 | 4.20 | 343 | 343 | 337 | 326 | 315 | 303 | 292 | 281 | 270 | 259 | 248 | 238 | 228 | 219 |
| | 5/16 | 89.8 | 26.33 | 4.18 | 395 | 395 | 388 | 375 | 362 | 349 | 336 | 323 | 310 | 298 | 285 | 273 | 262 | 251 |
| | 3/8 | 95.7 | 28.08 | 4.17 | 421 | 421 | 413 | 400 | 386 | 372 | 358 | 344 | 330 | 317 | 304 | 291 | 279 | 267 |
| | 14 × 1/2 | 107.6 | 31.58 | 4.16 | 474 | 474 | 465 | 449 | 433 | 417 | 401 | 386 | 370 | 356 | 341 | 327 | 313 | 300 |
| | 5/8 | 119.5 | 35.08 | 4.15 | 526 | 526 | 516 | 498 | 481 | 463 | 445 | 428 | 411 | 394 | 378 | 362 | 347 | 333 |
| | 3/4 | 131.4 | 38.58 | 4.14 | 579 | 579 | 566 | 547 | 528 | 508 | 489 | 470 | 451 | 433 | 415 | 398 | 381 | 365 |
| 12″ × 35.0# | 14 × 1/4 | 93.8 | 25.77 | 4.12 | 387 | 387 | 378 | 365 | 352 | 339 | 326 | 313 | 300 | 288 | 276 | 264 | 253 | 242 |
| | 5/16 | 99.8 | 29.27 | 4.11 | 439 | 439 | 429 | 414 | 399 | 384 | 369 | 355 | 341 | 326 | 313 | 300 | 287 | 275 |
| | 3/8 | 105.7 | 31.02 | 4.10 | 465 | 465 | 454 | 438 | 422 | 407 | 391 | 375 | 360 | 345 | 331 | 317 | 304 | 291 |
| | 1/2 | 117.6 | 34.52 | 4.10 | 518 | 518 | 505 | 488 | 470 | 453 | 435 | 418 | 401 | 384 | 368 | 353 | 338 | 323 |
| | 14 × 5/8 | 129.5 | 38.02 | 4.09 | 570 | 570 | 556 | 536 | 517 | 498 | 478 | 459 | 441 | 422 | 405 | 388 | 371 | 355 |
| | 3/4 | 141.4 | 41.52 | 4.09 | 623 | 623 | 607 | 586 | 565 | 543 | 522 | 502 | 481 | 461 | 442 | 424 | 406 | 388 |
| | 7/8 | 153.4 | 45.02 | 4.08 | 675 | 675 | 657 | 635 | 612 | 588 | 565 | 543 | 521 | 499 | 479 | 458 | 438 | 420 |
| | 1 | 165.2 | 48.52 | 4.08 | 728 | 728 | 708 | 684 | 659 | 634 | 609 | 585 | 561 | 538 | 516 | 493 | 473 | 452 |
| 12″ × 40.0# | 14 × 1/4 | 103.8 | 28.71 | 4.04 | 431 | 431 | 418 | 403 | 388 | 373 | 359 | 344 | 330 | 316 | 303 | 289 | 277 | 265 |
| | 5/16 | 109.8 | 32.21 | 4.04 | 483 | 483 | 469 | 452 | 436 | 419 | 402 | 386 | 370 | 355 | 340 | 325 | 311 | 298 |
| | 3/8 | 115.7 | 33.96 | 4.04 | 509 | 509 | 494 | 477 | 459 | 441 | 424 | 407 | 390 | 374 | 358 | 342 | 328 | 314 |
| | 1/2 | 127.6 | 37.46 | 4.04 | 562 | 562 | 545 | 526 | 506 | 487 | 468 | 449 | 430 | 412 | 395 | 378 | 361 | 346 |
| | 14 × 5/8 | 139.5 | 40.96 | 4.04 | 614 | 614 | 596 | 575 | 554 | 532 | 512 | 491 | 471 | 451 | 432 | 413 | 395 | 378 |
| | 3/4 | 151.4 | 44.46 | 4.04 | 667 | 667 | 647 | 624 | 601 | 578 | 555 | 533 | 511 | 490 | 469 | 448 | 429 | 411 |
| | 7/8 | 163.4 | 47.96 | 4.04 | 719 | 719 | 698 | 673 | 648 | 623 | 599 | 575 | 551 | 528 | 505 | 483 | 463 | 443 |
| | 1 | 175.2 | 51.46 | 4.04 | 772 | 772 | 749 | 722 | 696 | 669 | 643 | 616 | 591 | 567 | 542 | 519 | 497 | 475 |

The 1/4″ Plates are tabulated with all weights of Channels, as adding some sectional area, without costing appreciably more than lattice bars and batten plates: 75% of their area is included in the functions and column areas.
Weights given do not include Rivets or other details.
Loads to right of heavy vertical lines are for secondary members ONLY.

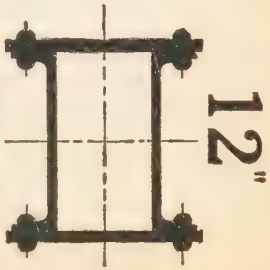
# DIMENSIONS AND FUNCTIONS OF 12″ CHANNEL COLUMNS WITH COVER PLATES

| 2 Channels | 2 Cover Plates | DIMENSIONS d | b | w | c | g | m | h | o | t | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12″ × 20.7# | 14 × 1/4 | 12 1/2 | 14 | 8 | 10 | 11 | 1 1/2 | 7 1/2 | 1 3/4 | .280 | 3/4 | 453 | 72.5 | 5.12 | 332 | 47.5 | 4.38 |
| | 5/16 | 12 5/8 | " | " | " | " | " | " | " | " | " | 588 | 93.1 | 5.31 | 390 | 55.6 | 4.33 |
| | 3/8 | 12 3/4 | " | " | " | " | " | " | " | " | " | 658 | 103.3 | 5.40 | 418 | 59.7 | 4.30 |
| | 14 × 7/16 | 12 7/8 | 14 | 8 | 10 | 11 | 1 1/2 | 7 1/2 | 1 3/4 | .280 | 3/4 | 731 | 113.6 | 5.48 | 447 | 63.8 | 4.29 |
| | 1/2 | 13 | " | " | " | " | " | " | " | " | " | 804 | 123.7 | 5.56 | 475 | 67.9 | 4.27 |
| | 5/8 | 13 1/4 | " | " | " | " | " | " | " | " | " | 954 | 143.9 | 5.68 | 532 | 76.1 | 4.24 |
| 12″ × 25.0# | 14 × 1/4 | 12 1/2 | 14 | 8 | 10 | 11 | 1 1/2 | 7 1/4 | 1 7/8 | .387 | 3/4 | 484 | 77.4 | 4.93 | 366 | 52.3 | 4.29 |
| | 5/16 | 12 5/8 | " | " | " | " | " | " | " | " | " | 619 | 98.0 | 5.14 | 423 | 60.5 | 4.25 |
| | 3/8 | 12 3/4 | " | " | " | " | " | " | " | " | " | 689 | 108.1 | 5.23 | 452 | 64.5 | 4.24 |
| | 14 × 7/16 | 12 7/8 | 14 | 8 | 10 | 11 | 1 1/2 | 7 1/4 | 1 7/8 | .387 | 3/4 | 762 | 118.2 | 5.32 | 480 | 68.6 | 4.23 |
| | 1/2 | 13 | " | " | " | " | " | " | " | " | " | 835 | 128.4 | 5.40 | 509 | 72.7 | 4.22 |
| | 5/8 | 13 1/4 | " | " | " | " | " | " | " | " | " | 984 | 148.6 | 5.53 | 566 | 80.9 | 4.20 |
| 12″ × 30.0# | 14 × 1/4 | 12 1/2 | 14 | 8 | 10 | 11 | 1 1/2 | 7 | 2 | .510 | 3/4 | 519 | 83.1 | 4.77 | 403 | 57.6 | 4.20 |
| | 5/16 | 12 5/8 | " | " | " | " | " | " | " | " | " | 654 | 103.6 | 4.98 | 460 | 65.8 | 4.18 |
| | 3/8 | 12 3/4 | " | " | " | " | " | " | " | " | " | 724 | 113.6 | 5.08 | 489 | 69.9 | 4.17 |
| | 14 × 1/2 | 13 | 14 | 8 | 10 | 11 | 1 1/2 | 7 | 2 | .510 | 3/4 | 870 | 133.9 | 5.25 | 546 | 78.0 | 4.16 |
| | 5/8 | 13 1/4 | " | " | " | " | " | " | " | " | " | 1020 | 153.9 | 5.39 | 603 | 86.2 | 4.15 |
| | 3/4 | 13 1/2 | " | " | " | " | " | " | " | " | " | 1176 | 174.2 | 5.52 | 661 | 94.4 | 4.14 |
| 12″ × 35.0# | 14 × 1/4 | 12 1/2 | 14 | 8 | 10 | 11 | 1 1/2 | 6 3/4 | 2 1/8 | .632 | 3/4 | 555 | 88.7 | 4.64 | 437 | 62.4 | 4.12 |
| | 5/16 | 12 5/8 | " | " | " | " | " | " | " | " | " | 689 | 109.2 | 4.85 | 494 | 70.5 | 4.11 |
| | 3/8 | 12 3/4 | " | " | " | " | " | " | " | " | " | 760 | 119.2 | 4.95 | 522 | 74.6 | 4.10 |
| | 1/2 | 13 | " | " | " | " | " | " | " | " | " | 905 | 139.2 | 5.12 | 580 | 82.8 | 4.10 |
| | 14 × 5/8 | 13 1/4 | 14 | 8 | 10 | 11 | 1 1/2 | 6 3/4 | 2 1/8 | .632 | 3/4 | 1055 | 159.2 | 5.27 | 637 | 91.0 | 4.09 |
| | 3/4 | 13 1/2 | " | " | " | " | " | " | " | " | " | 1212 | 179.5 | 5.40 | 694 | 99.1 | 4.09 |
| | 7/8 | 13 3/4 | " | " | " | " | " | " | " | " | " | 1374 | 199.8 | 5.52 | 751 | 107.3 | 4.08 |
| | 1 | 14 | " | " | " | " | " | " | " | " | " | 1543 | 220.3 | 5.64 | 808 | 115.5 | 4.08 |
| 12″ × 40.0# | 14 × 1/4 | 12 1/2 | 14 | 8 | 10 | 11 | 1 1/2 | 6 1/2 | 2 1/4 | .755 | 3/4 | 590 | 94.4 | 4.53 | 469 | 67.0 | 4.04 |
| | 5/16 | 12 5/8 | " | " | " | " | " | " | " | " | " | 725 | 114.8 | 4.74 | 526 | 75.1 | 4.04 |
| | 3/8 | 12 3/4 | " | " | " | " | " | " | " | " | " | 795 | 124.7 | 4.84 | 554 | 79.2 | 4.04 |
| | 1/2 | 13 | " | " | " | " | " | " | " | " | " | 940 | 144.6 | 5.01 | 612 | 87.4 | 4.04 |
| | 14 × 5/8 | 13 1/4 | 14 | 8 | 10 | 11 | 1 1/2 | 6 1/2 | 2 1/4 | .755 | 3/4 | 1090 | 164.6 | 5.16 | 669 | 95.5 | 4.04 |
| | 3/4 | 13 1/2 | " | " | " | " | " | " | " | " | " | 1247 | 184.7 | 5.29 | 726 | 103.7 | 4.04 |
| | 7/8 | 13 3/4 | " | " | " | " | " | " | " | " | " | 1409 | 204.9 | 5.42 | 783 | 111.9 | 4.04 |
| | 1 | 14 | " | " | " | " | " | " | " | " | " | 1578 | 225.4 | 5.53 | 840 | 120.0 | 4.04 |

.75 of 14″ × 1/4″ plates used in areas and functions.




I. is Moment of Inertia.
S. is Section Modulus.
r. is Radius of Gyration



## ALLOWABLE CONCENTRIC LOADS IN KIPS FOR 15″ CHANNEL COLUMNS WITH COVER PLATES

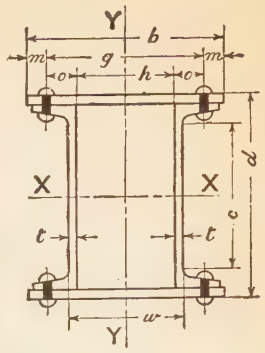
| 2 Channels | 2 Cover Plates | Weight Per Foot | Area Sq. Inches | Least Radius Gyr. | UNSUPPORTED LENGTH IN FEET | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 |
| 15″ × 33.9# | 16 × 1/4 | 95.0 | 25.05 | 5.12 | 376 | 376 | 376 | 374 | 364 | 354 | 343 | 333 | 323 | 313 | 303 | 293 | 283 | 274 |
| | 3/8 | 108.6 | 31.80 | 5.02 | 477 | 477 | 477 | 471 | 458 | 445 | 432 | 419 | 405 | 392 | 379 | 367 | 355 | 342 |
| | 7/16 | 115.4 | 33.80 | 5.00 | 507 | 507 | 507 | 500 | 486 | 473 | 458 | 444 | 430 | 416 | 402 | 389 | 376 | 363 |
| | 16 × 1/2 | 122.2 | 35.80 | 4.98 | 537 | 537 | 537 | 529 | 514 | 499 | 484 | 469 | 454 | 439 | 425 | 411 | 397 | 383 |
| | 5/8 | 135.8 | 39.80 | 4.94 | 597 | 597 | 597 | 586 | 570 | 553 | 537 | 520 | 503 | 486 | 470 | 454 | 438 | 423 |
| | 3/4 | 149.4 | 43.80 | 4.91 | 657 | 657 | 657 | 644 | 625 | 607 | 589 | 570 | 551 | 533 | 515 | 498 | 480 | 463 |
| 15″ × 35.0# | 16 × 1/4 | 97.2 | 25.71 | 5.07 | 386 | 386 | 386 | 382 | 372 | 361 | 351 | 340 | 330 | 319 | 309 | 299 | 289 | 279 |
| | 3/8 | 110.8 | 32.46 | 4.98 | 487 | 487 | 487 | 480 | 467 | 453 | 439 | 426 | 412 | 398 | 385 | 372 | 360 | 348 |
| | 1/2 | 124.4 | 36.46 | 4.94 | 547 | 547 | 547 | 537 | 522 | 507 | 491 | 476 | 461 | 446 | 430 | 416 | 401 | 387 |
| | 16 × 5/8 | 138.0 | 40.46 | 4.91 | 607 | 607 | 607 | 595 | 578 | 561 | 544 | 526 | 509 | 492 | 475 | 460 | 443 | 428 |
| | 3/4 | 151.6 | 44.46 | 4.89 | 667 | 667 | 667 | 653 | 634 | 615 | 596 | 577 | 558 | 540 | 521 | 503 | 486 | 469 |
| | 7/8 | 165.2 | 48.46 | 4.87 | 727 | 727 | 727 | 710 | 690 | 669 | 648 | 628 | 607 | 586 | 566 | 547 | 528 | 509 |
| 15″ × 40.0# | 16 × 1/4 | 107.2 | 28.65 | 5.02 | 430 | 430 | 430 | 425 | 413 | 401 | 389 | 377 | 365 | 354 | 342 | 331 | 319 | 308 |
| | 3/8 | 120.8 | 35.40 | 4.95 | 531 | 531 | 531 | 522 | 507 | 492 | 478 | 463 | 448 | 433 | 418 | 404 | 391 | 377 |
| | 1/2 | 134.4 | 39.40 | 4.92 | 591 | 591 | 591 | 580 | 563 | 546 | 530 | 513 | 496 | 480 | 464 | 448 | 433 | 417 |
| | 16 × 5/8 | 148.0 | 43.40 | 4.89 | 651 | 651 | 651 | 637 | 619 | 600 | 582 | 563 | 545 | 527 | 509 | 491 | 474 | 457 |
| | 3/4 | 161.6 | 47.40 | 4.87 | 711 | 711 | 711 | 695 | 675 | 655 | 634 | 614 | 593 | 574 | 554 | 535 | 516 | 498 |
| | 7/8 | 175.2 | 51.40 | 4.85 | 771 | 771 | 771 | 752 | 730 | 708 | 686 | 664 | 642 | 620 | 599 | 578 | 558 | 538 |
| 15″ × 45.0# | 16 × 1/4 | 117.2 | 31.59 | 4.93 | 474 | 474 | 474 | 465 | 452 | 439 | 426 | 412 | 399 | 385 | 372 | 360 | 347 | 335 |
| | 1/2 | 144.4 | 42.34 | 4.86 | 635 | 635 | 635 | 620 | 602 | 584 | 566 | 548 | 530 | 512 | 495 | 477 | 460 | 444 |
| | 5/8 | 158.0 | 46.34 | 4.84 | 695 | 695 | 695 | 677 | 658 | 638 | 618 | 598 | 578 | 558 | 539 | 520 | 502 | 484 |
| | 3/4 | 171.6 | 50.34 | 4.82 | 755 | 755 | 755 | 735 | 713 | 692 | 670 | 648 | 627 | 605 | 584 | 564 | 544 | 524 |
| | 16 × 7/8 | 185.2 | 54.34 | 4.80 | 815 | 815 | 815 | 792 | 769 | 745 | 722 | 698 | 674 | 652 | 629 | 606 | 585 | 564 |
| | 1″ | 198.8 | 58.34 | 4.79 | 875 | 875 | 875 | 849 | 824 | 799 | 774 | 749 | 723 | 698 | 674 | 650 | 627 | 604 |
| | 1 1/8 | 212.4 | 62.34 | 4.78 | 935 | 935 | 934 | 907 | 880 | 853 | 826 | 799 | 772 | 745 | 719 | 694 | 669 | 645 |
| | 1 1/4 | 226.0 | 66.34 | 4.77 | 995 | 995 | 993 | 965 | 936 | 907 | 878 | 849 | 820 | 792 | 764 | 737 | 711 | 685 |
| 15″ × 50.0# | 16 × 1/4 | 127.2 | 34.53 | 4.89 | 518 | 518 | 518 | 507 | 492 | 478 | 463 | 448 | 434 | 419 | 405 | 391 | 377 | 364 |
| | 1/2 | 154.4 | 45.28 | 4.83 | 679 | 679 | 679 | 662 | 643 | 623 | 603 | 584 | 564 | 545 | 526 | 508 | 490 | 472 |
| | 5/8 | 168.0 | 49.28 | 4.81 | 739 | 739 | 739 | 719 | 698 | 677 | 655 | 634 | 613 | 592 | 571 | 551 | 531 | 512 |
| | 3/4 | 181.6 | 53.28 | 4.80 | 799 | 799 | 799 | 777 | 754 | 731 | 708 | 684 | 661 | 639 | 616 | 595 | 573 | 553 |
| | 16 × 7/8 | 195.2 | 57.28 | 4.79 | 859 | 859 | 859 | 834 | 809 | 785 | 760 | 735 | 710 | 686 | 662 | 638 | 616 | 593 |
| | 1″ | 208.8 | 61.28 | 4.78 | 919 | 919 | 918 | 892 | 865 | 838 | 812 | 785 | 759 | 732 | 707 | 682 | 658 | 634 |
| | 1 1/8 | 222.4 | 65.28 | 4.77 | 979 | 979 | 977 | 949 | 921 | 892 | 864 | 836 | 807 | 779 | 752 | 725 | 699 | 674 |
| | 1 1/4 | 236.0 | 69.28 | 4.76 | 1039 | 1039 | 1036 | 1007 | 977 | 946 | 916 | 885 | 856 | 826 | 797 | 768 | 741 | 714 |
| 15″ × 50.0# | 18 × 1/4 | 130.6 | 34.53 | 5.67 | 518 | 518 | 518 | 518 | 518 | 507 | 495 | 483 | 470 | 457 | 444 | 432 | 420 | 407 |
| | 3/4 | 191.8 | 56.28 | 5.59 | 844 | 844 | 844 | 844 | 844 | 823 | 803 | 782 | 761 | 740 | 719 | 698 | 677 | 657 |
| | 7/8 | 207.2 | 60.78 | 5.56 | 912 | 912 | 912 | 912 | 909 | 887 | 865 | 842 | 819 | 796 | 774 | 751 | 729 | 707 |
| | 1″ | 222.4 | 65.28 | 5.54 | 979 | 979 | 979 | 979 | 976 | 952 | 928 | 903 | 879 | 854 | 829 | 805 | 781 | 757 |
| | 18 × 1 1/8 | 237.7 | 69.78 | 5.51 | 1047 | 1047 | 1047 | 1047 | 1041 | 1015 | 989 | 963 | 936 | 910 | 883 | 858 | 832 | 807 |
| | 1 1/4 | 253.0 | 74.28 | 5.49 | 1114 | 1114 | 1114 | 1114 | 1107 | 1079 | 1051 | 1023 | 995 | 966 | 938 | 911 | 883 | 856 |
| | 1 3/8 | 268.4 | 78.78 | 5.48 | 1182 | 1182 | 1182 | 1182 | 1173 | 1144 | 1114 | 1084 | 1054 | 1024 | 994 | 964 | 935 | 906 |
| | 1 1/2 | 283.6 | 83.28 | 5.46 | 1249 | 1249 | 1249 | 1249 | 1238 | 1208 | 1176 | 1144 | 1112 | 1080 | 1048 | 1018 | 987 | 956 |

The 1/4″ Plates are tabulated with all weights of Channels, as adding some sectional area, without costing appreciably more than lattice bars and batten plates; 65 5/8% of the 16″ × 1/4″ and 58 1/3% of the 18″ × 1/4″ plates are included in the functions and column areas. Weights given do not include Rivets or other details.

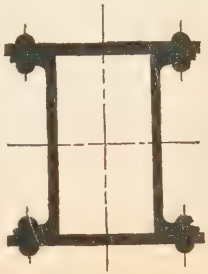
# DIMENSIONS AND FUNCTIONS OF 15″ CHANNEL COLUMNS WITH COVER PLATES

| 2 Channels | 2 Cover Plates | DIMENSIONS d | b | w | c | g | m | h | o | t | Riv. | AXIS X-X I | S | r | AXIS Y-Y I | S | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15″ × 33.9# | 16 × 1/4 | 15 1/2 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 3/4 | 2 1/8 | .400 | 7/8 | 930 | 120.1 | 6.09 | 657 | 82.1 | 5.12 |
| | 3/8 | 15 3/4 | " | " | " | " | " | " | " | " | " | 1334 | 169.4 | 6.48 | 801 | 100.1 | 5.02 |
| | 7/16 | 15 7/8 | " | " | " | " | " | " | " | " | " | 1459 | 183.9 | 6.57 | 843 | 105.4 | 5.00 |
| | 16 × 1/2 | 16 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 3/4 | 2 1/8 | .400 | 7/8 | 1587 | 198.3 | 6.66 | 886 | 110.7 | 4.98 |
| | 5/8 | 16 1/4 | " | " | " | " | " | " | " | " | " | 1846 | 227.3 | 6.81 | 971 | 121.4 | 4.94 |
| | 3/4 | 16 1/2 | " | " | " | " | " | " | " | " | " | 2115 | 256.3 | 6.95 | 1057 | 132.1 | 4.91 |
| 15″ × 35.0# | 16 × 1/4 | 15 1/2 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 5/8 | 2 3/16 | .422 | 7/8 | 943 | 121.6 | 6.06 | 661 | 82.7 | 5.07 |
| | 3/8 | 15 3/4 | " | " | " | " | " | " | " | " | " | 1347 | 171.0 | 6.44 | 805 | 100.7 | 4.98 |
| | 1/2 | 16 | " | " | " | " | " | " | " | " | " | 1599 | 199.9 | 6.62 | 891 | 111.4 | 4.94 |
| | 16 × 5/8 | 16 1/4 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 5/8 | 2 3/16 | .422 | 7/8 | 1859 | 228.8 | 6.78 | 976 | 122.0 | 4.91 |
| | 3/4 | 16 1/2 | " | " | " | " | " | " | " | " | " | 2127 | 257.8 | 6.92 | 1061 | 132.7 | 4.89 |
| | 7/8 | 16 3/4 | " | " | " | " | " | " | " | " | " | 2403 | 287.0 | 7.04 | 1147 | 143.4 | 4.87 |
| 15″ × 40.0# | 16 × 1/4 | 15 1/2 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 1/2 | 2 1/4 | .520 | 7/8 | 998 | 128.7 | 5.90 | 723 | 90.3 | 5.02 |
| | 3/8 | 15 3/4 | " | " | " | " | " | " | " | " | " | 1402 | 178.0 | 6 29 | 867 | 108.3 | 4.95 |
| | 1/2 | 16 | " | " | " | " | " | " | " | " | " | 1654 | 206.8 | 6.48 | 952 | 119.0 | 4.92 |
| | 16 × 5/8 | 16 1/4 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 1/2 | 2 1/4 | .520 | 7/8 | 1914 | 235.5 | 6.64 | 1037 | 129.7 | 4.89 |
| | 3/4 | 16 1/2 | " | " | " | " | " | " | " | " | " | 2182 | 264.5 | 6.78 | 1123 | 140.3 | 4.87 |
| | 7/8 | 16 3/4 | " | " | " | " | " | " | " | " | " | 2458 | 293 5 | 6.92 | 1208 | 151.0 | 4.85 |
| 15″ × 45.0# | 16 × 1/4 | 15 1/2 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 1/4 | 2 3/8 | .618 | 7/8 | 1053 | 135.9 | 5.77 | 769 | 96.1 | 4.93 |
| | 1/2 | 16 | " | " | " | " | " | " | " | " | " | 1709 | 213.7 | 6.35 | 998 | 124.8 | 4.86 |
| | 5/8 | 16 1/4 | " | " | " | " | " | " | " | " | " | 1969 | 242.4 | 6.52 | 1084 | 135.5 | 4.84 |
| | 3/4 | 16 1/2 | " | " | " | " | " | " | " | " | " | 2237 | 271.2 | 6.67 | 1169 | 146.1 | 4.82 |
| | 16 × 7/8 | 16 3/4 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 1/4 | 2 3/8 | .618 | 7/8 | 2514 | 300.1 | 6.80 | 1254 | 156.8 | 4.80 |
| | 1″ | 17 | " | " | " | " | " | " | " | " | " | 2798 | 329.2 | 6.93 | 1340 | 167.5 | 4.79 |
| | 1 1/8 | 17 1/4 | " | " | " | " | " | " | " | " | " | 3092 | 358.4 | 7.04 | 1425 | 178.1 | 4.78 |
| | 1 1/4 | 17 1/2 | " | " | " | " | " | " | " | " | " | 3393 | 387.8 | 7.15 | 1510 | 188.8 | 4.77 |
| 15″ × 50.0# | 16 × 1/4 | 15 1/2 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 1/8 | 2 7/16 | .716 | 7/8 | 1108 | 143.0 | 5.67 | 827 | 103.3 | 4.89 |
| | 1/2 | 16 | " | " | " | " | " | " | " | " | " | 1764 | 220.5 | 6 24 | 1056 | 132.0 | 4.83 |
| | 5/8 | 16 1/4 | " | " | " | " | " | " | " | " | " | 2024 | 249.1 | 6.41 | 1141 | 142.7 | 4.81 |
| | 3/4 | 16 1/2 | " | " | " | " | " | " | " | " | " | 2292 | 277.8 | 6.56 | 1227 | 153.3 | 4.80 |
| | 16 × 7/8 | 16 3/4 | 16 | 9 1/2 | 12 3/8 | 13 | 11 1/2 | 8 1/8 | 2 7/16 | .716 | 7/8 | 2569 | 306.7 | 6.70 | 1312 | 164.0 | 4.79 |
| | 1″ | 17 | " | " | " | " | " | " | " | " | " | 2854 | 335.8 | 6.82 | 1397 | 174.7 | 4.78 |
| | 1 1/8 | 17 1/4 | " | " | " | " | " | " | " | " | " | 3147 | 364.8 | 6.94 | 1483 | 185.3 | 4.77 |
| | 1 1/4 | 17 1/2 | " | " | " | " | " | " | " | " | " | 3448 | 394.1 | 7 06 | 1568 | 196.0 | 4.76 |
| 15″ × 50.0# | 18 × 1/4 | 15 1/2 | 18 | 11 1/2 | 12 3/8 | 15 | 11 1/2 | 10 1/8 | 2 7/16 | .716 | 7/8 | 1108 | 143.0 | 5.67 | 1170 | 130.1 | 5.82 |
| | 3/4 | 16 1/2 | " | " | " | " | " | " | " | " | " | 2478 | 300.4 | 6.64 | 1758 | 195.3 | 5.59 |
| | 7/8 | 16 3/4 | " | " | " | " | " | " | " | " | " | 2789 | 333.1 | 6.77 | 1879 | 208.8 | 5.56 |
| | 1″ | 17 | " | " | " | " | " | " | " | " | " | 3110 | 365.9 | 6.90 | 2001 | 222.3 | 5.54 |
| | 18 × 1 1/8 | 17 1/4 | 18 | 11 1/2 | 12 3/8 | 15 | 11 1/2 | 10 1/8 | 2 7/16 | .716 | 7/8 | 3440 | 398.8 | 7.02 | 2122 | 235.8 | 5.51 |
| | 1 1/4 | 17 1/2 | " | " | " | " | " | " | " | " | " | 3779 | 431.9 | 7.13 | 2244 | 249.3 | 5.49 |
| | 1 3/8 | 17 3/4 | " | " | " | " | " | " | " | " | " | 4129 | 465.2 | 7.24 | 2365 | 262.8 | 5.48 |
| | 1 1/2 | 18 | " | " | " | " | " | " | " | " | " | 4488 | 498 7 | 7.34 | 2487 | 276.3 | 5 46 |

.65625 of 16″ × 1/4″ plates used in areas and functions.
.58333 of 18″ × 1/4″ plates used in areas and functions.




I. is Moment of Inertia.
S. is Section Modulus.
r. is Radius of Gyration.



15″

## NOTES and DIAGRAMS

# Part IV
# Section 14

## Steel Slab Column Bases

# SOLID STEEL SLABS FOR COLUMN BASES

The size of slabs that can now be rolled is limited by the size of the ingot produced and the capacity of the rolling mill. Slabs have been rolled up to 120″ x 120″ x 9″ thick, weighing 36,000 #, and can be rolled up to 12″ thick and weighing 40,000 #.

Rolled steel slabs, especially those 2″ thick and over, are likely to be more or less bowed flatwise. If the material is sheared hot there will be 3″ to 5″ of deformation adjacent to the shear. All slabs over 2½″ thick and those 2½″ thick with a carbon content of more than .25% must be cut with a flame cutting torch. Slabs cut with the flame cutting torch do not show deformation adjacent to the cut. All slabs 4″ and under in thickness can be straightened by a press, but those thicker than 4″ must be machine faced where accuracy is required.

When ordering material for rolled steel slabs the following is suggested:

Specify ordinary Open Hearth steel with a carbon content of .10% to .25% and without incorporating the same physical requirements as fixed for structural steel.

Show finished dimensions only and state whether material is required hot sheared or flame cut to length.

Show what machining is to be done, namely on one face, both faces, or possibly both faces and four edges.

The mill should be instructed to add to these specified dimensions sufficient material to allow for machined finish.

Below is a table giving the width and thickness of material as usually rolled for slab use. The range of sizes will be found sufficient to cover any but very special cases, and as stated above the mills are now able to furnish slabs up to 12″ in thickness and 40,000 # in weight.

TABLE I

AVAILABLE SIZES OF STEEL SLABS

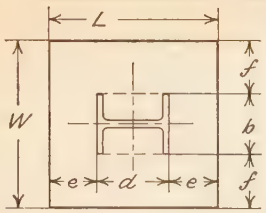
| Width | Thickness | Length | Weight per Linear In. | Width | Thickness | Length | Weight per Linear In. |
|---|---|---|---|---|---|---|---|
| 16″ | 2″ | 6′-8″ to 60′- 0″ | 9.07 | 44″ | 6 | 11′-3″ to 14′-2″ | 74.80 |
| 20 | 2 | 6′-8″ to 50′- 0″ | 11.33 | 48 | 5½ | 11′-3″ to 14′-0″ | 74.80 |
| 20 | 2½ | 6′-8″ to 36′- 8″ | 14.17 | 48 | 6 | 11′-3″ to 14′-0″ | 81.60 |
| 24 | 2½ | 6′-8″ to 36′- 8″ | 17.00 | 48 | 6½ | 9′-7″ to 12′-0″ | 88.40 |
| 24 | 3 | 6′-8″ to 24′- 2″ | 20.40 | 52 | 6 | 11′-3″ to 14′-7″ | 88.40 |
| 28 | 3 | 6′-8″ to 24′- 2″ | 23.80 | 52 | 6½ | 9′-7″ to 12′-6″ | 95.77 |
| 28 | 3½ | 6′-8″ to 18′- 4″ | 27.77 | 56 | 6½ | 10′-0″ to 11′-8″ | 103.10 |
| 32 | 3½ | 6′-8″ to 18′- 4″ | 31.73 | 56 | 7 | 10′-0″ to 11′-8″ | 111.07 |
| 32 | 4 | 6′-8″ to 18′- 4″ | 36.27 | 60 | 7 | | 119.00 |
| 36 | 4 | 6′-8″ to 22′-11″ | 40.80 | 60 | 8 | | 136.00 |
| 36 | 4½ | 6′-8″ to 22′-11″ | 45.90 | 66 | 8 | | 149.60 |
| 40 | 4½ | 6′-8″ to 20′-10″ | 51.00 | 66 | 9 | | 168.30 |
| 40 | 5 | 6′-8″ to 20′-10″ | 56.67 | 72 | 9 | | 183.60 |
| 44 | 5 | 13′-9″ to 17′- 1″ | 62.33 | 72 | 10 | | 204.00 |
| 44 | 5½ | 11′-3″ to 14′- 2″ | 68.57 | | | | |

TABLE II

AVERAGE ALLOWABLE UNIT PRESSURES ON MASONRY IN POUNDS PER SQUARE INCH

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Common Brick | — | Lime Mortar | = 100 | Sandstone | — | Port. Cem. Mortar | = 400 |
| Rubble Masonry | — | Lime Mortar | = 150 | Limestone | — | Port. Cem. Mortar | = 500 |
| Common Brick | — | Port. Cem. Mortar | = 200 | Concrete | — | Port. Cement 1:2:4 | = 600 |
| Rubble Masonry | — | Port. Cem. Mortar | = 200 | Granite | — | Port. Cem. Mortar | = 800 |
| Hard Brick | — | Port. Cem. Mortar | = 250 | | | | |

# SOLID STEEL SLABS FOR COLUMN BASES




C = Total Load on Column in pounds
L = Length of Slab in inches
W = Width of Slab in inches
d = depth of Column in inches
b = width of Column in inches
A = Area of the Slab = L x W
U = Unit pressure per square inch on lower side of slab = C ÷ A

The column is assumed as having uniform bearing on the slab over the entire area of the milled end of the column shaft. It is also assumed that a part of the slab which is the smallest rectangle which will enclose the column cross section will act as a continuation of the column and that the maximum bending moment in the slab will occur at the sides of this rectangle. While these assumptions are empirical they are considered conservative since for the sake of simplicity in the calculations various other factors are omitted which if considered would materially add to the strength of the slab.

The determing bending moment will occur on that side of the enclosing rectangle for which the overhang "e" or "f" is greatest. In the following calculation a section of the slab is considered which is one inch in width and "t" inches in depth.

The square of the required slab thickness "t" is obtained as given below:—

M = Moment for 1" width of slab = $U \times e \times \frac{e}{2} = \frac{U \times e^2}{2}$ or $\frac{U \times f^2}{2}$ .....(1)

S = Sec. Mod. for 1" width of slab = $\frac{M}{18000} = \frac{U \times e^2}{36000}$ or $\frac{U \times f^2}{36000}$ .....(2)

Since $S = t^2 \div 6 \quad \therefore \quad t^2 = \frac{U \times e^2}{6000}$ or $\frac{U \times f^2}{6000}$ .....(3)

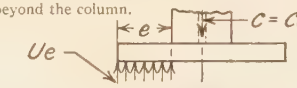
Having the value of $t^2$, the required slab may be selected from table III, which is arranged to show the value of $t^2$ for usual available thicknesses.

Slabs 4" and less in thickness can be straightened and do not require planing. For slabs over 4" there has been deducted 1/4" for planing under the column and also 3/8" for planing the bottom surface when required.

## EXPLANATION OF STRESS FORMULAE

Slabs:—The stresses on the slab are considered as those of an inverted cantilever in which the length of the cantilever is the amount of the projection of the slab beyond the column.

Max. Moment = $Ue \times \frac{e}{2}$

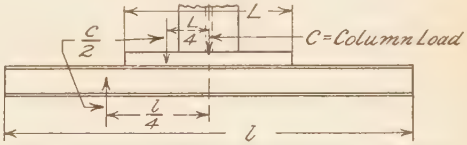



Grillage:—The stresses on the grillage beams are considered as those of a simple beam, and the Max. Moment therefore occurs at the center.

Max. Moment = $\frac{C}{2} \times \frac{l}{4} - \frac{C}{2} \times \frac{L}{4}$

$= \frac{C}{2}\left(\frac{l-L}{4}\right)$

$= \frac{C(l-L)}{8}$



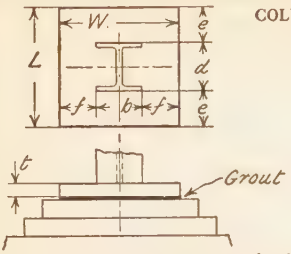

## TABLE III

## VALUES FOR $t^2$ FOR VARIOUS THICKNESSES

| $t^2$ | Slab thickness | | | $t^2$ | Slab thickness | | |
|---|---|---|---|---|---|---|---|
| | Rough | Machine faced | | | Rough | Machine faced | |
| | | Top only | Top & Bottom | | | Top only | Top & Bottom |
| 6.25 | 2½ | | | 39.06 | 6½ | 6¼ | |
| 9.00 | 3 | | | 40.64 | 7 | | 6⅜ |
| 12.25 | 3½ | | | 45.56 | 7 | 6¾ | |
| 16.00 | 4 | | | 54.39 | 8 | | 7⅜ |
| 15.02 | 4½ | | 3⅞ | 60.06 | 8 | 7¾ | |
| 18.06 | 4½ | 4¼ | | 70.14 | 9 | | 8⅜ |
| 19.14 | 5 | | 4⅜ | 76.56 | 9 | 8¾ | |
| 22.56 | 5 | 4¾ | | 87.89 | 10 | | 9⅜ |
| 23.77 | 5½ | | 4⅞ | 95.06 | 10 | 9¾ | |
| 27.56 | 5½ | 5¼ | | 107.64 | 11 | | 10⅜ |
| 28.90 | 6 | | 5⅜ | 115.56 | 11 | 10¾ | |
| 33.06 | 6 | 5¾ | | 129.39 | 12 | | 11⅜ |
| 34.51 | 6½ | | 5⅞ | 138.06 | 12 | 11¾ | |

# SOLID STEEL SLABS FOR COLUMN BASES

## COLUMN BASE RESTING UPON MASONRY




C = Total Load on Column in pounds
L = Length of Slab in inches
W = Width of Slab in inches
t = Thickness of Slab in inches
U = Allowable Unit Pressure on Masonry (Table II)
A = Area of the Slab base in square inches = C ÷ U

The area of the slab base must first be computed from the Unit Pressure allowed on the type of Masonry to be used for the foundation and the Load on the Column. $A = C \div U$

Select a slab having a rolled width of one of the dimensions L or W (see Table I). The thickness of the slab is then computed as shown on the preceding page.

Slab bases resting on masonry need not be machine faced on the bottom but should be grouted.

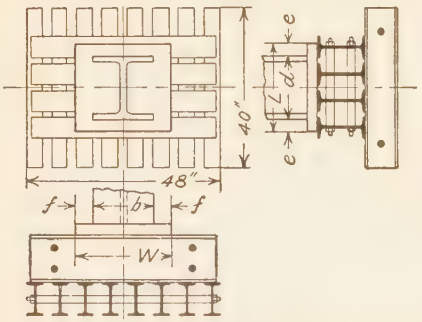
Example:—

Column Load = 960000# ; Column dimensions, d = 15.75″ and b = 15.25″; Unit Pressure on Masonry, U = 600
Then A = 960000 ÷ 600 = 1600 sq. inches = 40″ × 40″ Slab base

Then $e = \frac{40 - 15.75}{2} = 12.125$ and $f = \frac{40 - 15.25}{2} = 12.375$ $\therefore t^2 = 600 \times 12.375 \times 12.375 \div 6000 = 15.31$

This value of $t^2$ requires a slab 4½″ thick machine faced on top. (Table III)

## COLUMN BASE RESTING UPON GRILLAGE




C = Total Load on Column in pounds
L = Length of Slab in inches
W = Width of Slab in inches
t = Thickness of Slab in inches
U = Allowable Unit Pressure on Masonry (Table II)
A = Area of the Slab base in square inches = C ÷ U

The area of the grillage is determined by the Unit pressure allowed on the type of Masonry to be used for the foundation, and the shape is often determined by the building conditions.

Select a slab having a rolled width of one of the dimensions L or W. (See Table I). W should not be less than 30% of the length of the grillage and L must extend at least ¾″ beyond the center lines of the outside grillage beams. The thickness of the slab is computed as shown on the preceding page.

Slab bases resting on grillage must be true and flat and if over 4″ thick must be machine faced on top and bottom.

Upper tier grillage beams should be spaced with 1″ minimum clear distance between the flanges. Lower tier beams should have 2″ minimum clearance and a maximum of ¾ of the flange width.

Example:—

Column Load = 960000# ; Column dimensions, d = 15.75″ and b = 15.25″; Size of Grillage = 4′ - 0″ × 3′ - 4″
Grillage = 48″ × 40″ = 1920 sq. inches. Therefore:—Unit pressure on masonry foundation = 500# per sq. inch.
Column base:—W = 24″ and L = 22″. Then A = 528 sq. inches and U = C ÷ A = 1818

Then $e = \frac{22 - 15.75}{2} = 3.125$ and $f = \frac{24 - 15.25}{2} = 4.375$ $\therefore t^2 = \frac{1818}{6000} \times \frac{4.375}{1} \times \frac{4.375}{1} = 5.80$

This requires use of a slab 2½″ thick (Table III)

### Upper tier grillage beams

Max. Bending Moment = $\frac{960000\ (48-24)}{8}$ = 2880000″#

4-I$^S$ 12″-45# good for 852300″# each = 3409200″#

Max. Shear = $\frac{960000}{48} \times \frac{(48-24)}{2}$ = 240000 #

4-I$^S$ 12″-45# good for 81400# each = 325600 #

*Web Buckling. Total Load = 960000 #

I$^S$ 12″-45# good for 8475# per inch of web+8475 x d/2

4-I$^S$ 12″-45# good for $4 \times 8475 \times \left(24 + \frac{12}{2}\right)$ = 1017000#

### Lower tier grillage beams

Max. Bending Moment = $\frac{960000(40-25.235)}{8}$ = 1771800″#

†8-I$^S$ 8″-20.5# good for 270900″# each = 2167200″#

Max. Shear = $\frac{960000}{40} \times \frac{40-25.235}{2}$ = 177180 #

†8-I$^S$ 8″-20.5# good for 33500# each = 268000 #

*Web Buckling. Total Load = 960000 #

I$^S$ 8″-20.5# good for 5235# per inch of web+5235 x d/2

†8-I$^S$ 8″-20.5# good for $8 \times 5235 \times \left(25.235 + \frac{8}{2}\right)$ = 1224360#

*See table of end reactions and notes below.

†Seven beams have the required strength. Eight are necessary due to the limit allowed for space between flanges.

# Part IV

# Section 15

## Miscellaneous Rolled Steel Sections

**Dimensions**

**Technical Functions**

## T Bars

## Z Bars

## J & L Stair Stringer Channel

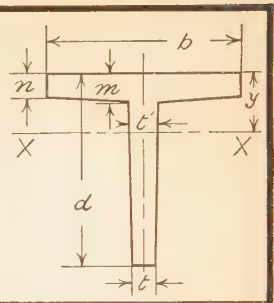
**3/4" to 1 3/4"**

# T BARS

## EQUAL LEGS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Stem Shear in Pounds

T Bar Sections have not been standardized.
Those listed below are representative sections rolled by various mills.
Slight variations in dimensions occur.

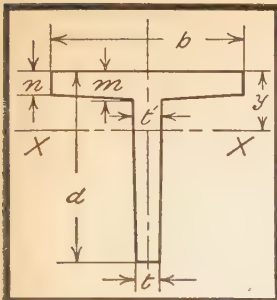



| Size (width of flange) | | | 3/4" | 7/8" | 1" | | | |
|---|---|---|---|---|---|---|---|---|
| Weight | | | .61 | .73 | .80 | .85 | .89 | 1.25 |
| Depth = d" | | | 3/4 | 7/8 | 1" | 1" | 1" | 1" |
| Area | | | .18 | .21 | .22 | .25 | .26 | .37 |
| b | | | 3/4 | 7/8 | 1" | 1" | 1" | 1" |
| T to T' | | | 1/8* | 1/8* | 7/64 to 1/8 | 1/8* | 1/8 to 5/32 | 3/16 to 7/32 |
| M to N | | | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 to 5/32 | 3/16 to 7/32 |
| y | | | 24 | 27 | 28 | 30 | 29 | 32 |
| AXES X-X | I | | .01 | 01 | 02 | 02 | 02 | 03 |
| | S | | .02 | 02 | 03 | 03 | 03 | .05 |
| | r | | .22 | 26 | .31 | 30 | 30 | 29 |
| AXES Y-Y | I | | .005 | .01 | 01 | 01 | 01 | .02 |
| | S | | .01 | 02 | 02 | 02 | 02 | 04 |
| | r | | 16 | .18 | 21 | 21 | 21 | 22 |
| Coef. Strength | | | 240 | 200 | 330 | 340 | 340 | 530 |
| Max. Mom. "# | | | 350 | 300 | 500 | 510 | 510 | 790 |
| V | | | 1130 | 1310 | 1400 | 1500 | 1690 | 2440 |

| Size (width of flange) | | | 1 1/8" | 1 3/16" | 1 1/4" | | | |
|---|---|---|---|---|---|---|---|---|
| Weight | | | 1.37 | 1.51 | 1.59 | 1.60 | 1.70 | 2.02 |
| Depth = d" | | | 1 1/8 | 1 3/16 | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/4 |
| Area | | | 40 | 44 | 47 | 47 | 50 | 59 |
| b | | | 1 1/8 | 1 3/16 | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/4 |
| T to T' | | | 5/32 to 7/32 | 5/32 to 7/32 | 3/16 to 7/32 | 5/32 to 7/32 | 3/16 to 9/32 | 1/4 to 9/32 |
| M to N | | | 3/16 to 7/32 | 3/16 to 1/4 | 3/16 to 7/32 | 3/16 to 1/4 | 3/16 to 7/32 | 1/4 to 9/32 |
| y | | | 33 | 34 | 38 | 36 | 40 | 40 |
| AXES X-X | I | | 04 | 05 | 06 | 06 | 07 | 08 |
| | S | | 05 | 06 | 07 | 06 | 08 | 10 |
| | r | | 31 | 33 | 37 | 35 | 37 | 37 |
| AXES Y-Y | I | | 02 | 03 | 03 | 03 | 03 | 05 |
| | S | | 04 | 05 | 05 | 05 | 05 | 07 |
| | r | | 24 | 26 | 27 | 27 | 26 | 28 |
| Coef. Strength | | | 600 | 710 | 830 | 810 | 990 | 1130 |
| Max. Mom. "# | | | 910 | 1060 | 1240 | 1210 | 1480 | 1694 |
| V | | | 2530 | 2670 | 3050 | 2810 | 3520 | 3980 |

| Size (width of flange) | | | 1 1/2" | | 1 3/4" | | |
|---|---|---|---|---|---|---|---|
| Weight | | | 1.94 | 2.47 | 2.28 | 2.93 | 3.09 |
| Depth = d" | | | 1 1/2 | 1 1/2 | 1 3/4 | 1 3/4 | 1 3/4 |
| Area | | | 57 | 73 | 67 | 86 | 91 |
| b | | | 1 1/2 | 1 1/2 | 1 3/4 | 1 3/4 | 1 3/4 |
| T to T' | | | 3/16 to 7/32 | 1/4 to 9/32 | 3/16 to 7/32 | 1/4 to 9/32 | 1/4 to 5/16 |
| M to N | | | 3/16 to 7/32 | 1/4 to 9/32 | 3/16 to 7/32 | 1/4 to 9/32 | 1/4 to 5/16 |
| y | | | 44 | 47 | 50 | 53 | 54 |
| AXES X-X | I | | .11 | .15 | .19 | 23 | .23 |
| | S | | 11 | 14 | 15 | 19 | 19 |
| | r | | .45 | .45 | .53 | .52 | 51 |
| AXES Y-Y | I | | 06 | .08 | .09 | 12 | .12 |
| | S | | 08 | 10 | .10 | .13 | 14 |
| | r | | 32 | 32 | .35 | .37 | 37 |
| Coef. Strength | | | 1250 | 1750 | 1820 | 2260 | 2280 |
| Max. Mom. "# | | | 1870 | 2620 | 2740 | 3390 | 3420 |
| V | | | 3660 | 4780 | 4270 | 5580 | 5910 |

*Each side of Stem has taper of about one degree.




# T BARS

EQUAL LEGS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Stem Shear in Pounds

T Bar Sections have not been standardized.
Those listed below are representative sections rolled by various mills.
Slight variations in dimensions occur.

**2″ to 6 1/2″**

| Size (width of flange) | | | 2″ | | | | 2 ¼″ | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Weight | | | 3.38 | 3.56 | 4.1 | 4.3 | 3.83 | 4.1 | 4.7 | 4.9 |
| Depth = d″ | | | 2″ | 2″ | 2″ | 2″ | 2 ¼ | 2 ¼ | 2 ¼ | 2 ¼ |
| Area | | | 1.00 | 1.05 | 1.20 | 1 26 | 1.13 | 1.19 | 1.38 | 1.43 |
| b″ | | | 2″ | 2″ | 2″ | 2″ | 2 ¼ | 2 ¼ | 2 ¼ | 2 ¼ |
| T to T′ | | | ¼ to 9/32 | ¼ to 5/16 | 5/16 to 11/32 | 5/16 to 3/8 | ¼ to 9/32 | ¼ to 5/16 | 5/16 to 11/32 | 5/16 to 3/8 |
| M to N | | | ¼ to 9/32 | ¼ to 5/16 | 5/16 to 11/32 | 5/16 to 3/8 | ¼ to 9/32 | ¼ to 5/16 | 5/16 to 11/32 | 5/16 to 3/8 |
| y | | | .59 | .59 | .61 | .61 | .65 | .65 | .67 | .68 |
| AXES | X-X | I | .36 | .37 | .42 | .44 | .52 | .52 | .62 | .65 |
| | | S | .25 | .26 | .31 | 31 | .32 | .32 | .39 | .41 |
| | | r | .60 | .59 | .59 | .59 | .68 | 66 | .67 | 67 |
| | Y-Y | I | .18 | .18 | .22 | .23 | .25 | .25 | .31 | .33 |
| | | S | .18 | .18 | .22 | .23 | .22 | .22 | .28 | .29 |
| | | r | .42 | .42 | .43 | 43 | .47 | .46 | 47 | 48 |
| Coef. Strength | | | 3060 | 3150 | 3630 | 3800 | 3900 | 3900 | 4710 | 4970 |
| Max. Mom. ″ # | | | 4600 | 4720 | 5440 | 5700 | 5850 | 5850 | 7060 | 7450 |
| V | | | 6370 | 6750 | 7870 | 8250 | 7170 | 7590 | 8860 | 9280 |

| Size (width of flange) | | | 2 ½″ | | | 3″ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Weight | | | 4.6 | 5.5 | 6.4 | 5.5 | 6.7 | 7.8 | 9.0 | 12.2 |
| Depth = d″ | | | 2 ½ | 2 ½ | 2 ½ | 3″ | 3″ | 3″ | 3″ | 3″ |
| Area | | | 1.33 | 1.60 | 1 88 | 1 61 | 1 95 | 2 27 | 2 65 | 3 52 |
| b″ | | | 2 ½ | 2 ½ | 2 ½ | 3″ | 3″ | 3″ | 3″ | 3″ |
| T to T′ | | | ¼ to 5/16 | 5/16 to 3/8 | 3/8 to 7/16 | ¼ to 5/16 | 5/16 to 3/8 | 3/8 to 7/16 | 7/16 to ½ | ½ to 9/16 |
| M to N | | | ¼ to 5/16 | 5/16 to 3/8 | 3/8 to 7/16 | 5/16 to 3/8 | 5/16 to 3/8 | 3/8 to 7/16 | 7/16 to ½ | ¾ to 13/16 |
| y | | | .71 | .74 | .76 | .82 | 86 | .88 | .90 | 89 |
| AXES | X-X | I | .74 | .88 | 1 02 | 1 33 | 1 61 | 1 84 | 2 06 | 2 32 |
| | | S | .42 | .50 | .59 | .61 | 74 | 86 | .98 | 1.10 |
| | | r | .75 | .74 | .74 | 91 | 90 | .90 | 88 | .81 |
| | Y-Y | I | .34 | .44 | .52 | .61 | .75 | .90 | 1 05 | 1.76 |
| | | S | .27 | .35 | .42 | .40 | .50 | 60 | .70 | 1.17 |
| | | r | .51 | .52 | .53 | 61 | 62 | .63 | .63 | .71 |
| Coef. Strength | | | 4960 | 6000 | 7030 | 7320 | 9030 | 10420 | 11770 | 13190 |
| Max. Mom. ″ # | | | 7440 | 9000 | 10550 | 10980 | 13540 | 15620 | 17660 | 19790 |
| V | | | 8440 | 10310 | 12190 | 10130 | 12380 | 14630 | 16880 | 19130 |

| Size (width of flange) | | | 3 ½″ | | | 4″ | | | 6 ½″ |
|---|---|---|---|---|---|---|---|---|---|
| Weight | | | 9.2 | 10.3 | 11.7 | 10.5 | 12.1 | 13.5 | 19.8 |
| Depth = d″ | | | 3 ½ | 3 ½ | 3 ½ | 4″ | 4″ | 4″ | 6 ½ |
| Area | | | 2.70 | 3 09 | 3 44 | 3 09 | 3 56 | 3 97 | 5 80 |
| b″ | | | 3 ½ | 3 ½ | 3 ½ | 4″ | 4″ | 4″ | 6 ½ |
| T to T′ | | | 3/8 to 7/16 | 7/16 to ⅛ | ½ to 9/16 | 3/8 to 7/16 | 7/16 to ½ | ½ to 9/16 | 0 45 |
| M to N | | | 3/8 to 7/16 | 7/16 to ½ | ½ to 9/16 | 3/8 to 7/16 | 7/16 to ½ | ½ to 9/16 | 40 to 55 |
| y | | | 1.00 | 1.02 | 1.05 | 1.13 | 1.14 | 1.18 | 1 76 |
| AXES | X-X | I | 3 00 | 3.38 | 3 73 | 4 5 | 5 17 | 5 72 | 23 5 |
| | | S | 1 20 | 1.36 | 1.53 | 1 6 | 1 81 | 2 03 | 5 0 |
| | | r | 1 05 | 1 05 | 1 04 | 1 21 | 1 20 | 1 20 | 2 01 |
| | Y-Y | I | 1.39 | 1 65 | 1 91 | 2.1 | 2 46 | 2 81 | 10 1 |
| | | S | .80 | .95 | 1.09 | 1.1 | 1 23 | 1 40 | 3 1 |
| | | r | .72 | .73 | .74 | .83 | .83 | .84 | 1 32 |
| Coef. Strength | | | 14400 | 16350 | 18270 | 18820 | 21690 | 24340 | 59490 |
| Max. Mom. ″ # | | | 21600 | 24530 | 27400 | 28220 | 32540 | 36510 | 89240 |
| V | | | 17060 | 19690 | 22310 | 19500 | 22500 | 25500 | 35100 |

# $1\frac{1}{4}$" to 3"

## T BARS

### UNEQUAL LEGS

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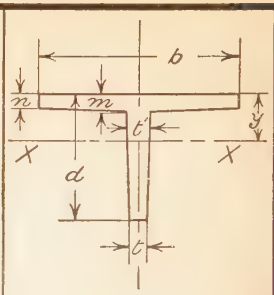
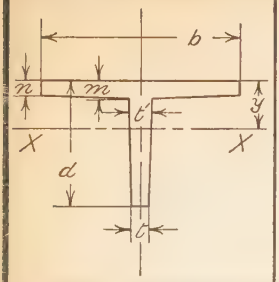



| Size (width of flange) | | | 1 ¼" | | 1 ½" | | |
|---|---|---|---|---|---|---|---|
| Weight | | | 1.48 | 1.56 | 1.54 | 1.25 | 2.45 |
| Depth = d" | | | 1 1/16 | 1 1/8 | 1 1/16 | 1 1/4 | 2" |
| Area | | | .43 | .46 | .45 | .37 | .72 |
| b | | | 1 1/4 | 1 1/4 | 1 1/2 | 1 1/2 | 1 1/2 |
| T to T' | | | 5/32 to 7/32 | 3/16 to 1/4 | 3/16* to 3/16 | 1/8 to 5/32 | 3/16 to 1/4 |
| M to N | | | 3/16 to 1/4 | 3/16 to 7/32 | 3/16 to 3/16 | 1/8 to 5/32 | 3/16 to 1/4 |
| y | | | .30 | .34 | .29 | .33 | .63 |
| AXIS X-X | I | | .04 | .05 | .04 | .05 | .27 |
| | S | | .05 | .06 | .05 | .05 | .19 |
| | r | | .29 | .32 | .30 | .37 | .61 |
| AXIS Y-Y | I | | .03 | .03 | .03 | .04 | .06 |
| | S | | .05 | .05 | .07 | .05 | .08 |
| | r | | .28 | .27 | .34 | .32 | .92 |
| Coef. Strength | | | 630 | 770 | 620 | 660 | 1360 |
| Max. Mom. "#" | | | 940 | 1150 | 930 | 980 | 1880 |
| V | | | 2390 | 2950 | 2390 | 2110 | 5250 |

| Size (width of flange) | | | 1 ¾" | 2 7/16" | | 2 ½" |
|---|---|---|---|---|---|---|
| Weight | | | 1.43 | 3.62 | 4.2 | 6.1 |
| Depth = d" | | | 1 19/32 | 2" | 2" | 3" |
| Area | | | .42 | 1.06 | 1.23 | 1.77 |
| b | | | 1 3/4 | 2 7/16 | 2 7/16 | 2 1/2 |
| T to T' | | | 1/4 to 5/16 | 3/16 to 1/4 | 17/64 to 21/64 | 5/16 to 3/8 |
| M to N | | | 5/32 to 3/16 | 17/64 to 21/64 | 17/64 to 21/64 | 5/16 to 3/8 |
| y | | | .17 | .59 | .55 | .92 |
| AXIS X-X | I | | .04 | .32 | .41 | 1.35 |
| | S | | .02 | .28 | .28 | .77 |
| | r | | .15 | .61 | .58 | .92 |
| AXIS Y-Y | I | | .07 | .25 | .35 | .44 |
| | S | | .09 | .21 | .28 | .35 |
| | r | | .12 | .49 | .55 | .50 |
| Coef. Strength | | | 290 | 3320 | 3390 | 8660 |
| Max. Mom. "#" | | | 430 | 4980 | 5090 | 12990 |
| V | | | 2000 | 5250 | 7120 | 12380 |

| Size (width of flange) | | | 2 ¾" | 3 | | | |
|---|---|---|---|---|---|---|---|
| Weight | | | 2.52 | 6.1 | 8.5 | 9.7 | 10.8 |
| Depth = d" | | | 1 3/4 | 2 1/2 | 3 1/2 | 3 1/2 | 3 1/2 |
| Area | | | .74 | 1.77 | 2.50 | 2.85 | 3.17 |
| b | | | 2 3/4 | 3" | 3" | 3" | 3" |
| T to T' | | | 3/16 to 1/4 | 5/16 to 3/8 | 3/8 to 7/16 | 7/16 to 1/2 | 1/2 to 9/16 |
| M to N | | | 9/64 to 9/64 | 5/16 to 7/8 | 3/8 to 7/16 | 7/16 to 1/2 | 1/2 to 9/16 |
| y | | | .47 | .68 | 1.07 | 1.10 | 1.13 |
| AXIS X-X | I | | .21 | .94 | 2.18 | 3.20 | 3.50 |
| | S | | .16 | .52 | 1.20 | 1.30 | 1.50 |
| | r | | .88 | .73 | 1.07 | 1.06 | 1.06 |
| AXIS Y-Y | I | | .15 | .75 | .93 | 1.00 | 1.20 |
| | S | | .18 | .50 | .62 | .59 | .80 |
| | r | | .88 | .65 | .60 | .61 | .62 |
| Coef. Strength | | | 1970 | 6200 | 13830 | 16000 | 17650 |
| Max. Mom. "#" | | | 2960 | 9300 | 20740 | 24000 | 26480 |
| V | | | 4590 | 10310 | 17060 | 19690 | 22310 |

*Each side of Stem has taper of about one-half degree.




# T BARS

## UNEQUAL LEGS

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
V is Maximum Web Shear in Pounds

T Bar Sections have not been standardized.
Those listed below are representative sections rolled by various mills.
Slight variations in dimensions occur.

**3½" to 5"**

| Size (width of flange) | | | 3 ½" | | | | |
|---|---|---|---|---|---|---|---|
| Weight | | | 5.1 | 8.5 | 9.7 | 9.8 | 12.6 |
| Depth = d" | | | 2 ½ | 3 | 3 | 4 | 4 |
| Area | | | 1.48 | 2.50 | 2.85 | 2.88 | 3.70 |
| b | | | 3 ½ | 3 ½ | 3 ½ | 3 ½ | 3 ½ |
| T to T' | | | 9/32 to 11/32 | 3/8 to 7/16 | 7/16 to ½ | 3/8 to 7/16 | ½ to 9/16 |
| M to N | | | 3/16 to ¼ | 3/8 to 7/16 | 7/16 to ½ | 3/8 to 7/16 | ½ to 9/16 |
| y | | | .69 | .83 | .85 | 1.19 | 1.24 |
| AXES | X-X | I | .85 | 1.90 | 2.17 | 4.30 | 5.50 |
| | | S | .47 | .89 | 1.01 | 1.50 | 2.00 |
| | | r | .76 | .88 | .87 | 1.23 | 1.21 |
| | Y-Y | I | .74 | 1.40 | 1.65 | 1.40 | 1.90 |
| | | S | .42 | .81 | .94 | .81 | 1.10 |
| | | r | .71 | .75 | .76 | .70 | .72 |
| Coef. Strength | | | 5640 | 10510 | 12120 | 18370 | 23920 |
| Max. Mom. "# | | | 8460 | 15770 | 18170 | 27550 | 35870 |
| V | | | 9380 | 14630 | 16880 | 19500 | 25500 |

| Size (width of flange) | | | 4" | | | | | |
|---|---|---|---|---|---|---|---|---|
| Weight | | | 6.7 | 7.8 | 7.2 | 8.5 | 7.8 | 9.2 |
| Depth = d" | | | 2" | 2" | 2 ½ | 2 ½ | 3" | 3" |
| Area | | | 1.97 | 2.29 | 2.12 | 2.48 | 2.29 | 2.68 |
| b | | | 4" | 4" | 4" | 4" | 4" | 4" |
| T to T' | | | 5/16 to 3/8 | 3/8 to 7/16 | 5/16 to 3/8 | 3/8 to 7/16 | 5/16 to 3/8 | 3/8 to 7/16 |
| M to N | | | 5/16 to 3/8 | 3/8 to 7/16 | 5/16 to 3/8 | 3/8 to 7/16 | 5/16 to 3/8 | 3/8 to 7/16 |
| y | | | .46 | .48 | .60 | .62 | .75 | .76 |
| AXES | X-X | I | .53 | .60 | 1.0 | 1.2 | 1.7 | 2.0 |
| | | S | .34 | .40 | .53 | .62 | .77 | .90 |
| | | r | .52 | .52 | .69 | .69 | .87 | .86 |
| | Y-Y | I | 1.80 | 2.10 | 1.8 | 2.1 | 1.8 | 2.1 |
| | | S | .88 | 1.10 | .88 | 1.0 | .88 | 1.1 |
| | | r | .95 | .96 | .91 | .92 | .88 | .89 |
| Coef. Strength | | | 4130 | 4740 | 6320 | 7660 | 9070 | 10820 |
| Max. Mom. "# | | | 6200 | 7110 | 9480 | 11490 | 13600 | 16220 |
| V | | | 8250 | 9750 | 10310 | 12190 | 12380 | 14630 |

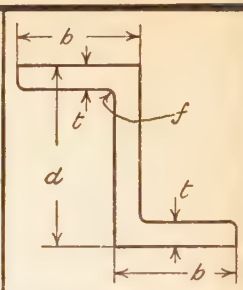
| Size (width of flange) | | | 4" | | | | 5 |
|---|---|---|---|---|---|---|---|
| Weight | | | 11.2 | 11.4 | 11.9 | 13.3 | 11.5 |
| Depth = d" | | | 4 ½ | 4 ½ | 5 | 5 | 5 |
| Area | | | 3.29 | 4.23 | 3.49 | 4.50 | 3.37 |
| b | | | 4" | 4" | 4" | 4" | 5" |
| T to T' | | | 3/8 to 7/16 | ½ to 9/16 | 3/8 to 7/16 | ½ to 9/16 | 13/32 to 5/8 |
| M to N | | | 3/8 to 7/16 | ½ to 9/16 | 3/8 to 7/16 | ½ to 9/16 | 3/8 to 7/16 |
| y | | | 1.31 | 1.37 | 1.51 | 1.56 | .76 |
| AXES | X-X | I | 6.3 | 7.9 | 8.5 | 10.8 | 2.1 |
| | | S | 2.0 | 2.5 | 2.4 | 3.1 | 1.1 |
| | | r | 1.39 | 1.37 | 1.56 | 1.55 | .84 |
| | Y-Y | I | 2.1 | 2.8 | 2.1 | 2.8 | 3.9 |
| | | S | 1.1 | 1.4 | 1.1 | 1.4 | 1.6 |
| | | r | .80 | .81 | .78 | .79 | 1.10 |
| Coef. Strength | | | 23700 | 30290 | 29230 | 37680 | 12860 |
| Max. Mom. "# | | | 35550 | 45440 | 43840 | 56520 | 19290 |
| V | | | 21940 | 28690 | 24380 | 31880 | 18560 |

3" & 4"

# Z BARS

**EQUAL LEGS**

**I** is Moment of Inertia
**S** is Section Modulus
**r** is Radius of Gyration
**V** is Maximum Web Shear in Pounds



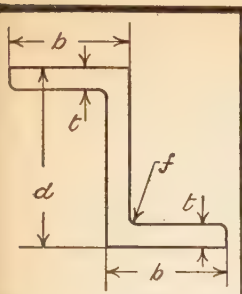

## 3" Z BARS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Weight per foot | | | 6.7 | 8.5 | 9.8 | 11.5 | 12.6 | 14.3 |
| Depth = d" | | | 3" | 3 1/16 | 3" | 3 1/16 | 3" | 3 1/16 |
| Area | | | 1.97 | 2.48 | 2.86 | 3.36 | 3.69 | 4.18 |
| b | | | 2 11/16 | 2 3/4 | 2 11/16 | 2 3/4 | 2 11/16 | 2 3/4 |
| t | | | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 |
| f | | | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 |
| AXES | X-X | I | 2.9 | 3.6 | 3.9 | 4.6 | 4.6 | 5.3 |
| | | S | 1.9 | 2.4 | 2.6 | 3.0 | 3.1 | 3.4 |
| | | r | 1.21 | 1.21 | 1.16 | 1.17 | 1.12 | 1.12 |
| | Y-Y | I | 2.8 | 3.6 | 3.9 | 4.8 | 4.9 | 5.7 |
| | | S | 1.1 | 1.4 | 1.6 | 1.9 | 2.0 | 2.3 |
| | | r | 1.19 | 1.21 | 1.17 | 1.19 | 1.15 | 1.17 |
| | Z-Z | r | .55 | .56 | .54 | .55 | .53 | .54 |
| Coef. Strength | | | 23200 | 28200 | 31200 | 36000 | 36800 | 41500 |
| Max. Mom." s | | | 34800 | 42300 | 46800 | 54100 | 55200 | 62300 |
| V | | | 9000 | 11500 | 13500 | 16100 | 18000 | 20700 |

## 4" Z BARS

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Weight per foot | | | 8.2 | 10.3 | 12.5 | 13.8 | 15.9 | 18.0 | 18.9 | 20.9 | 23.0 |
| Depth = d" | | | 4" | 4 1/16 | 4 1/8 | 4" | 4 1/16 | 4 1/8 | 4" | 4 1/16 | 4 1/8 |
| Area | | | 2.41 | 3 03 | 3.66 | 4 05 | 4 66 | 5.27 | 5.55 | 6 14 | 6.75 |
| b | | | 3 1/16 | 3 1/8 | 3 3/16 | 3 1/16 | 3 1/8 | 3 3/16 | 3 1/16 | 3 1/8 | 3 3/16 |
| t | | | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 |
| f | | | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 |
| AXES | X-X | I | 6.3 | 7.9 | 9.6 | 9.7 | 11.2 | 12.7 | 12.1 | 13.5 | 15.0 |
| | | S | 3.1 | 3.9 | 4.7 | 4.8 | 5.5 | 6.2 | 6.1 | 6.7 | 7.3 |
| | | r | 1.62 | 1.62 | 1.62 | 1.55 | 1.55 | 1.55 | 1.48 | 1.48 | 1.49 |
| | Y-Y | I | 4.2 | 5.5 | 6.8 | 6.7 | 8.0 | 9.3 | 8.7 | 10.0 | 11.2 |
| | | S | 1.4 | 1.8 | 2.3 | 2.4 | 2.8 | 3.2 | 3.2 | 3.6 | 4.0 |
| | | r | 1.33 | 1 34 | 1.36 | 1.29 | 1.31 | 1.33 | 1.25 | 1 27 | 1.29 |
| | Z-Z | r | .67 | .68 | .69 | .66 | .67 | .68 | .66 | .67 | .68 |
| Coef. Strength | | | 37800 | 46700 | 55900 | 58200 | 66200 | 73900 | 72600 | 79800 | 87300 |
| Max. Mom." s | | | 56700 | 70000 | 83800 | 87300 | 99200 | 110800 | 108900 | 119600 | 130900 |
| V | | | 12000 | 15200 | 18600 | 21000 | 24400 | 27800 | 30000 | 33500 | 37100 |

For Uniformly Distributed Loads for laterally supported Z bars, simple span, divide the Coefficient of Strength by the length of the span in feet.




# Z BARS

**EQUAL LEGS**

I is Moment of Inertia
S is Section Modulus
r is Radius of Gyration
v is Maximum Web Shear in Pounds

**5" & 6"**

## 5" Z BARS

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Weight per foot | | | 11.6 | 14.0 | 16.4 | 17.9 | 20.2 | 22.6 | 23.7 | 26.0 | 28.4 |
| Depth = d" | | | 5" | 5 1/16 | 5 1/8 | 5" | 5 1/16 | 5 1/8 | 5" | 5 1/16 | 5 1/8 |
| Area | | | 3.40 | 4.10 | 4.81 | 5.25 | 5.94 | 6.64 | 6.96 | 7.64 | 8.33 |
| b | | | 3 1/4 | 3 5/16 | 3 3/8 | 3 1/4 | 3 5/16 | 3 3/8 | 3 1/4 | 3 5/16 | 3 3/8 |
| t | | | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 |
| f | | | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 |
| AXES | X-X | I | 13.4 | 16.2 | 19.1 | 19.2 | 21.8 | 24.5 | 23.7 | 26.2 | 28.7 |
| | | S | 5.3 | 6.4 | 7.4 | 7.7 | 8.6 | 9.6 | 9.5 | 10.3 | 11.2 |
| | | r | 1.98 | 1.99 | 1.99 | 1.91 | 1.91 | 1.92 | 1.84 | 1.85 | 1.86 |
| | Y-Y | I | 6.2 | 7.7 | 9.2 | 9.1 | 10.5 | 12.1 | 11.4 | 12.8 | 14.4 |
| | | S | 2.0 | 2.5 | 2.9 | 3.0 | 3.5 | 3.9 | 3.9 | 4.4 | 4.8 |
| | | r | 1.35 | 1.37 | 1.38 | 1.31 | 1.33 | 1.35 | 1.28 | 1.30 | 1.31 |
| | Z-Z | r | .75 | .76 | .77 | .74 | .75 | .76 | .73 | .74 | .76 |
| Coef. Strength | | | 64300 | 76800 | 89400 | 92200 | 103300 | 114700 | 113800 | 124200 | 134400 |
| Max. Mom. "#" | | | 96500 | 115200 | 134200 | 138200 | 155000 | 172100 | 170600 | 186300 | 201600 |
| V | | | 18800 | 22800 | 26900 | 30000 | 34200 | 38400 | 41300 | 45600 | 50000 |

## 6" Z BARS

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Weight per foot | | | 15.7 | 18.4 | 21.1 | 22.8 | 25.4 | 28.1 | 29.4 | 32.0 | 34.6 |
| Depth = d" | | | 6" | 6 1/16 | 6 1/8 | 6" | 6 1/16 | 6 1/8 | 6" | 6 1/16 | 6 1/8 |
| Area | | | 4.59 | 5.39 | 6.19 | 6.68 | 7.46 | 8.25 | 8.63 | 9.40 | 10.17 |
| b | | | 3 1/2 | 3 9/16 | 3 5/8 | 3 1/2 | 3 9/16 | 3 5/8 | 3 1/2 | 3 9/16 | 3 5/8 |
| t | | | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 |
| f | | | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 | 5/16 |
| AXES | X-X | I | 25.3 | 29.8 | 34.4 | 34.6 | 38.9 | 43.2 | 42.1 | 46.1 | 50.2 |
| | | S | 8.4 | 9.8 | 11.2 | 11.5 | 12.8 | 14.1 | 14.0 | 15.2 | 16.4 |
| | | r | 2.35 | 2.35 | 2.36 | 2.28 | 2.28 | 2.29 | 2.21 | 2.22 | 2.22 |
| | Y-Y | I | 9.1 | 11.0 | 12.9 | 12.6 | 14.4 | 16.3 | 15.4 | 17.3 | 19.2 |
| | | S | 2.8 | 3.3 | 3.8 | 3.9 | 4.4 | 5.0 | 4.9 | 5.5 | 6.0 |
| | | r | 1.41 | 1.43 | 1.44 | 1.37 | 1.39 | 1.41 | 1.34 | 1.36 | 1.37 |
| | Z-Z | r | .83 | .83 | .84 | .81 | .82 | .84 | .81 | .82 | .83 |
| Coef. Strength | | | 101200 | 118000 | 134800 | 138400 | 154000 | 169300 | 168400 | 182500 | 196700 |
| Max. Mom. "#" | | | 151800 | 177000 | 202200 | 207600 | 231000 | 253900 | 252600 | 273700 | 295100 |
| V | | | 27000 | 31800 | 36800 | 40500 | 45500 | 50500 | 54000 | 59100 | 64300 |

For Uniformly Distributed Loads for laterally supported Z bars, simple span, divide the Coefficient of Strength by the length of the span in feet.

# 10″ & 12″

# J AND L STAIR STRINGER CHANNEL

## DIMENSIONS—FUNCTIONS—ALLOWABLE LOADS

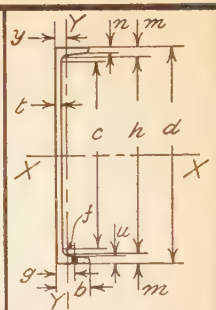
I is Moment of Inertia  S is Section Modulus

r is Radius of Gyration

V is Maximum Web Shear in Pounds.

P is Minimum Span in feet, uniformly loaded to cause V.

Rivet given is Maximum Diameter in flange.
Allowable concentrated center loads are 50% and their deflections 80% of those shown.



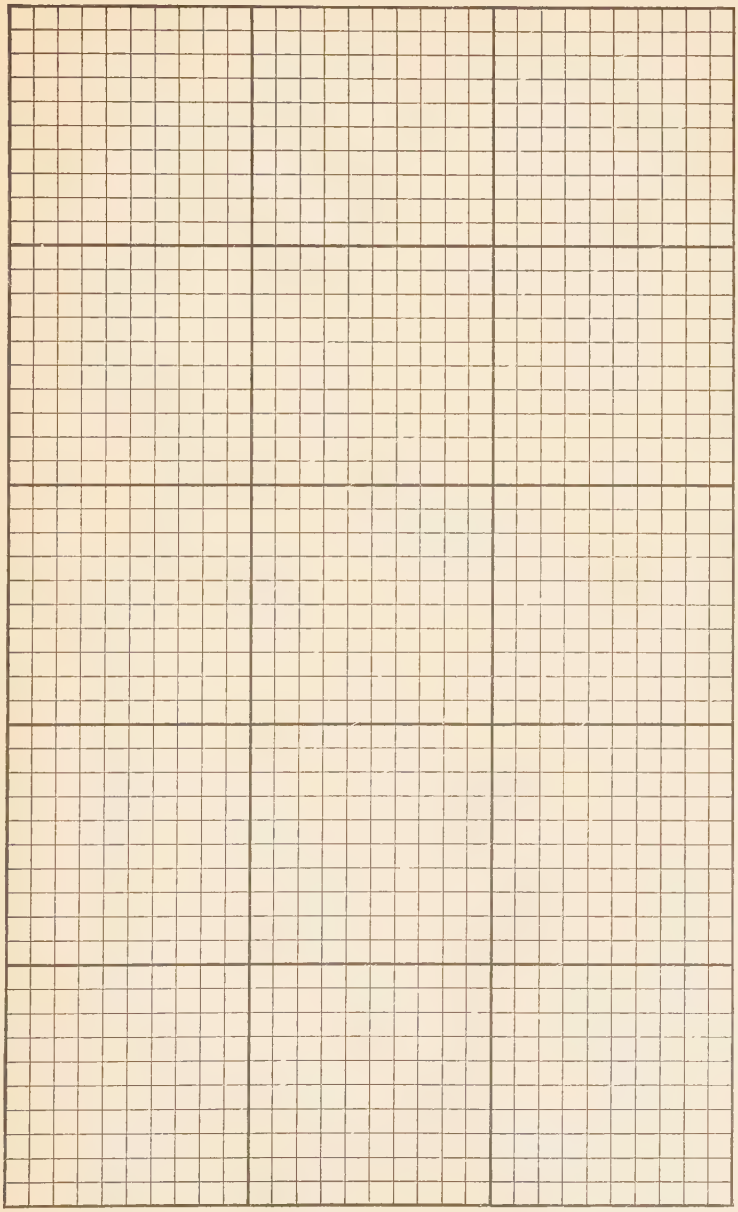

| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d″. | | 10.0 | 10.0 | Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load | | |
| Wt. per foot. | | 8.0 | 8.8 | | | |
| Area | | 2.34 | 2.57 | | | |
| b″ | | 1.500 | 1.523 | | | |
| t | | .164 | .1875 | | | |
| h | | 9.308 | 9.308 | | | |
| m | | .346 | .346 | | | |
| n | | .180 | .180 | | | |
| f | | .187 | .187 | | | |
| c | | 8.934 | 8 934 | | | |
| g | | 7/8 | 7/8 | | | |
| u | | 1/4 | 1/4 | | | |
| AXES | X-X | I | 30.3 | 32.2 | | |
| | | S | 6.06 | 6 44 | | |
| | | r | 3.60 | 3.54 | | |
| | Y-Y | I | .33 | .35 | | |
| | | S | .27 | .28 | | |
| | | r | .38 | .37 | | |
| | | y | .29 | .28 | | |
| Coef. Str. | | | 72720 | 77280 | Deflection in inches for Maximum Load; Laterally fixed beam. | |
| Max.Mom.″# | | | 109080 | 115920 | | |
| V | | | 19680 | 22500 | | |
| P. feet | | | 1.85 | 1.72 | | |
| Rivet dia. | | | ½ | ½ | | |

| Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet. | Span feet | Laterally fixed | Laterally free | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|---|---|
| | 1 | 39.4 | 39 4 | 45 0 | 45 0 | |
| | 2 | 36.4 | 35 8 | 38 6 | 38 1 | |
| | 3 | 24.2 | 20 8 | 25 7 | 22 3 | .017 |
| | 4 | 18.2 | 13 4 | 19 3 | 14 3 | 030 |
| | 5 | 14.5 | 8 9 | 15 5 | 9.7 | 047 |
| | 6 | 12 1 | | 12 9 | | 067 |
| | 7 | 10 4 | | 11 0 | | 091 |
| | 8 | 9 1 | | 9 7 | | 119 |
| | 9 | 8 1 | | 8 6 | | 151 |
| | 10 | 7 3 | | 7.7 | | 186 |
| | 11 | 6 6 | | 7 0 | | .225 |
| | 12 | 6 1 | | 6 4 | | 268 |
| | 13 | 5 6 | | 5 9 | | 315 |
| | 14 | 5 2 | | 5 5 | | 365 |
| | 15 | 4.8 | | 5.2 | | 419 |
| | 16 | 4.5 | | 4 8 | | 477 |
| | 17 | 4.3 | | 4.5 | | .538 |
| | 18 | 4.0 | | 4.3 | | 603 |
| | 19 | 3.8 | | 4.1 | | .672 |
| | 20 | 3.6 | | 3.9 | | .745 |

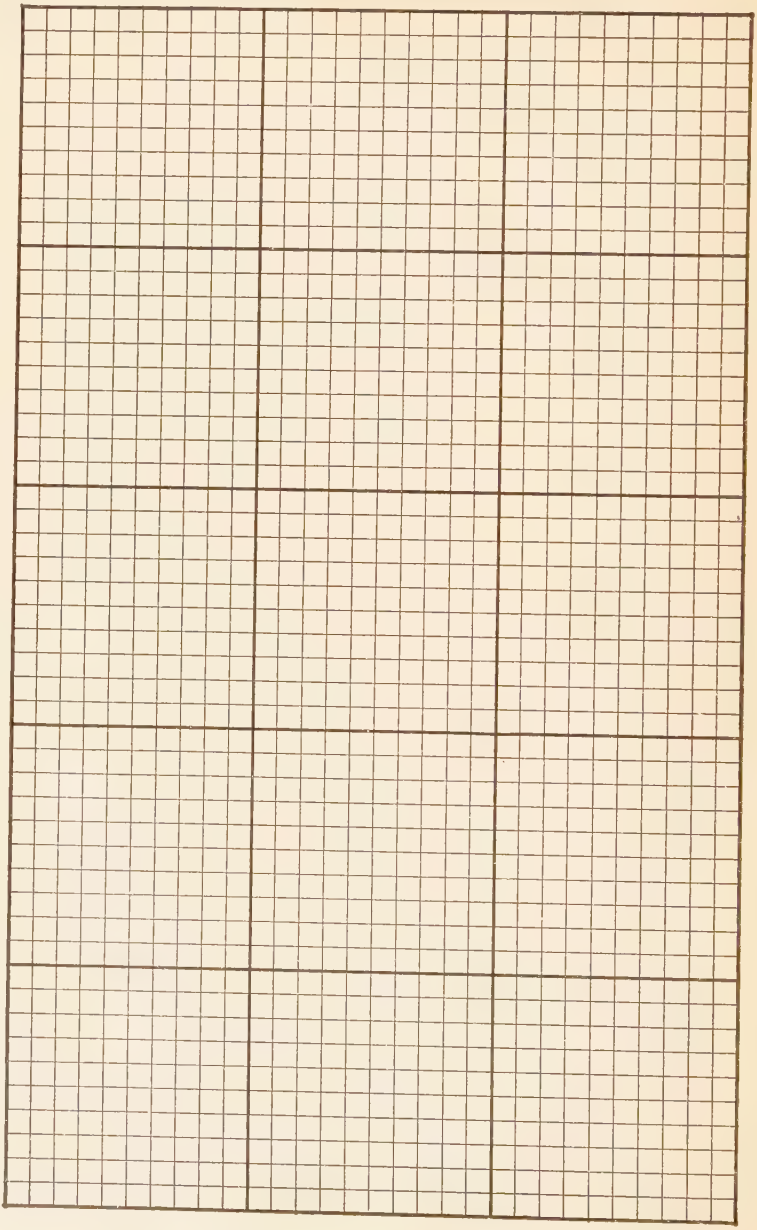
| | | | | | | |
|---|---|---|---|---|---|---|
| Depth = d″. | | 12.0 | Live Load deflection must not exceed 1/360 of the Span. Live Load Def. = Total Def. × Live Load / Tabular Load | | | |
| Wt. per foot. | | 10.6 | | | | |
| Area | | 3 12 | | | | |
| b″ | | 1 500 | | | | |
| t | | .190 | | | | |
| h | | 11.164 | | | | |
| m | | .418 | | | | |
| n | | 200 | | | | |
| f | | 250 | | | | |
| c | | 10 664 | | | | |
| g | | 7/8 | | | | |
| u | | 5/16 | | | | |
| AXES | X-X | I | 55 8 | | | |
| | | S | 9.30 | | | |
| | | r | 4 23 | | | |
| | Y-Y | I | 39 | | | |
| | | S | 32 | | | |
| | | r | 35 | | | |
| | | y | 27 | | | |
| Coef. Str. | | | 111600 | Deflection in inches for Maximum Load; Laterally fixed beam. | | |
| Max.Mom.″# | | | 167400 | | | |
| V | | | 27360 | | | |
| P. feet | | | 2 04 | | | |
| Rivet dia. | | | ½ | | | |

| Allowable Uniform Load in Kips, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet. | Span feet | Laterally fixed | Laterally free | Total Deflection in inches for Maximum Load; Laterally fixed beam. |
|---|---|---|---|---|
| | 1 | 54.7 | 54 7 | |
| | 2 | 54.7 | 54 7 | |
| | 3 | 37.2 | 32 5 | 014 |
| | 4 | 27.9 | 20 8 | 025 |
| | 5 | 22.3 | 13 8 | 039 |
| | 6 | 18 6 | | 056 |
| | 7 | 15 9 | | 076 |
| | 8 | 13 9 | | 099 |
| | 9 | 12 4 | | .126 |
| | 10 | 11 2 | | .155 |
| | 11 | 10.1 | | .188 |
| | 12 | 9.3 | | 223 |
| | 13 | 8.6 | | .263 |
| | 14 | 8.0 | | .304 |
| | 15 | 7.4 | | 349 |
| | 16 | 7.0 | | .398 |
| | 17 | 6.6 | | .448 |
| | 18 | 6.2 | | .503 |
| | 19 | 5.9 | | .560 |
| | 20 | 5.6 | | .621 |
| | 21 | 5.3 | | .684 |
| | 22 | 5.1 | | .751 |
| | 23 | 4.9 | | .820 |
| | 24 | 4.7 | | .894 |
| | 25 | 4.5 | | .970 |

## NOTES and DIAGRAMS



## NOTES and DIAGRAMS



# Part IV
# Section 16

## Rivets

Values in Plates

Values in Channel and Beam Webs

Dimensions, Weights, and Signs

Riveting Details

Lengths for various Grips

Reduction of Area in Plates

## Bolts

Dimensions and Weights

| SHEAR @ 13500 | WORKING VALUES FOR POWER DRIVEN RIVETS AND TURNED BOLTS IN REAMED HOLES | BEARING Single @ 24000 Double @ 30000 |
|---|---|---|

| Rivet dia. | ½″ | | ⅝″ | | ¾″ | | ⅞″ | | 1″ | | 1⅛″ | | 1¼″ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | .1963 | | .3068 | | .4418 | | .6013 | | .7854 | | .9940 | | 1.2272 | |
| Single Sh. | 2650 | | 4140 | | 5960 | | 8120 | | 10600 | | 13420 | | 16570 | |
| Double Sh. | 5300 | | 8280 | | 11930 | | 16240 | | 21200 | | 26840 | | 33130 | |
| Thickness of Plate | Bearing | | Bearing | | Bearing | | Bearing | | Bearing | | Bearing | | Bearing | |
| | 24000 | 30000 | 24000 | 30000 | 24000 | 30000 | 24000 | 30000 | 24000 | 30000 | 24000 | 30000 | 24000 | 30000 |
| .170 | 2040 | 2550 | 2550 | 3190 | 3060 | 3830 | 3570 | 4460 | 4080 | 5100 | 4590 | 5740 | 5100 | 6380 |
| .180 | 2160 | 2700 | 2700 | 3380 | 3240 | 4050 | 3780 | 4730 | 4320 | 5400 | 4860 | 6080 | 5400 | 6750 |
| .1875 3/16 | 2250 | 2810 | 2810 | 3520 | 3380 | 4220 | 3940 | 4920 | 4500 | 5630 | 5060 | 6330 | 5630 | 7030 |
| .190 | 2280 | 2850 | 2850 | 3560 | 3420 | 4280 | 3990 | 4990 | 4560 | 5700 | 5130 | 6410 | 5700 | 7130 |
| .200 | 2400 | 3000 | 3000 | 3750 | 3600 | 4500 | 4200 | 5250 | 4800 | 6000 | 5400 | 6750 | 6000 | 7500 |
| .210 | 2520 | 3150 | 3150 | 3940 | 3780 | 4730 | 4410 | 5510 | 5040 | 6300 | 5670 | 7090 | 6300 | 7880 |
| .220 | 2640 | 3300 | 3300 | 4130 | 3960 | 4950 | 4620 | 5780 | 5280 | 6600 | 5940 | 7430 | 6600 | 8250 |
| .230 | .... | 3450 | 3450 | 4310 | 4140 | 5180 | 4830 | 6040 | 5520 | 6900 | 6210 | 7760 | 6900 | 8630 |
| .240 | .... | 3600 | 3600 | 4500 | 4320 | 5400 | 5040 | 6300 | 5760 | 7200 | 6480 | 8100 | 7200 | 9000 |
| .250 1/4 | .... | 3750 | 3750 | 4690 | 4500 | 5630 | 5250 | 6560 | 6000 | 7500 | 6750 | 8440 | 7500 | 9380 |
| .260 | .... | 3900 | 3900 | 4880 | 4680 | 5850 | 5460 | 6830 | 6240 | 7800 | 7020 | 8780 | 7800 | 9750 |
| .270 | .... | 4050 | 4050 | 5060 | 4860 | 6080 | 5670 | 7090 | 6480 | 8100 | 7290 | 9110 | 8100 | 10130 |
| .280 | .... | 4200 | .... | 5250 | 5040 | 6300 | 5880 | 7350 | 6720 | 8400 | 7560 | 9450 | 8400 | 10500 |
| .290 | .... | 4350 | .... | 5440 | 5220 | 6530 | 6090 | 7610 | 6960 | 8700 | 7830 | 9790 | 8700 | 10880 |
| .300 | .... | 4500 | .... | 5630 | 5400 | 6750 | 6300 | 7880 | 7200 | 9000 | 8100 | 10130 | 9000 | 11250 |
| .310 | .... | 4650 | .... | 5810 | 5580 | 6980 | 6510 | 8140 | 7440 | 9300 | 8370 | 10460 | 9300 | 11630 |
| .312. 5/16 | .... | 4690 | .... | 5860 | 5630 | 7030 | 6560 | 8200 | 7500 | 9380 | 8440 | 10550 | 9380 | 11720 |
| .320 | .... | 4800 | .... | 6000 | 5760 | 7200 | 6720 | 8460 | 7680 | 9600 | 8640 | 10800 | 9600 | 12000 |
| .330 | .... | 4950 | .... | 6190 | 5940 | 7430 | 6930 | 8660 | 7920 | 9900 | 8910 | 11140 | 9900 | 12380 |
| .340 | .... | 5100 | .... | 6380 | 5960 | 7650 | 7140 | 8930 | 8160 | 10200 | 9180 | 11480 | 10200 | 12750 |
| .350 | .... | 5250 | .... | 6560 | .... | 7880 | 7350 | 9190 | 8400 | 10500 | 9450 | 11810 | 10500 | 13130 |
| .360 | .... | .... | .... | 6750 | .... | 8100 | 7560 | 9450 | 8640 | 10800 | 9720 | 12150 | 10800 | 13500 |
| .370 | .... | .... | .... | 6940 | .... | 8330 | 7770 | 9710 | 8880 | 11100 | 9990 | 12490 | 11100 | 13880 |
| .375 3/8 | .... | .... | .... | 7030 | .... | 8440 | 7880 | 9840 | 9000 | 11250 | 10130 | 12660 | 11250 | 14050 |
| .380 | .... | .... | .... | 7130 | .... | 8550 | 7980 | 9980 | 9120 | 11400 | 10260 | 12830 | 11400 | 14250 |
| .390 | .... | .... | .... | 7310 | .... | 8780 | .... | 10240 | 9360 | 11700 | 10530 | 13160 | 11700 | 14630 |
| .400 | .... | .... | .... | 7500 | .... | 9000 | .... | 10500 | 9600 | 12000 | 10800 | 13500 | 12000 | 15000 |
| .410 | .... | .... | .... | 7690 | .... | 9230 | .... | 10760 | 9840 | 12300 | 11070 | 13840 | 12300 | 15380 |
| .420 | .... | .... | .... | 7880 | .... | 9450 | .... | 11030 | 10080 | 12600 | 11340 | 14180 | 12600 | 15750 |
| .430 | .... | .... | .... | 8060 | .... | 9680 | .... | 11290 | 10320 | 12900 | 11610 | 14510 | 12900 | 16130 |
| .4375 7/16 | .... | .... | .... | 8200 | .... | 9840 | .... | 11480 | 10500 | 13130 | 11810 | 14770 | 13130 | 16410 |
| .440 | .... | .... | .... | 8250 | .... | 9900 | .... | 11550 | 10560 | 13200 | 11880 | 14850 | 13200 | 16500 |
| .450 | .... | .... | .... | .... | .... | 10130 | .... | 11810 | .... | 13500 | 12150 | 15190 | 13500 | 16880 |
| .460 | .... | .... | .... | .... | .... | 10350 | .... | 12080 | .... | 13800 | 12420 | 15530 | 13800 | 17250 |
| .470 | .... | .... | .... | .... | .... | 10580 | .... | 12340 | .... | 14100 | 12690 | 15860 | 14100 | 17630 |
| .480 | .... | .... | .... | .... | .... | 10800 | .... | 12600 | .... | 14400 | 12960 | 16200 | 14400 | 18000 |
| .490 | .... | .... | .... | .... | .... | 11030 | .... | 12860 | .... | 14700 | 13230 | 16540 | 14700 | 18380 |
| .500 1/2 | .... | .... | .... | .... | .... | 11250 | .... | 13130 | .... | 15000 | .... | 16880 | 15000 | 18750 |
| .510 | .... | .... | .... | .... | .... | 11480 | .... | 13390 | .... | 15300 | .... | 17210 | 15300 | 19130 |
| .520 | .... | .... | .... | .... | .... | 11760 | .... | 13650 | .... | 15600 | .... | 17550 | 15600 | 19500 |
| .530 | .... | .... | .... | .... | .... | 11930 | .... | 13910 | .... | 15900 | .... | 17890 | 15900 | 19880 |
| .540 | .... | .... | .... | .... | .... | 11930 | .... | 14180 | .... | 16200 | .... | 18230 | 16200 | 20250 |
| .550 | .... | .... | .... | .... | .... | .... | .... | 14440 | .... | 16500 | .... | 18560 | 16500 | 20630 |
| .560 | .... | .... | .... | .... | .... | .... | .... | 14700 | .... | 16800 | .... | 18900 | .... | 21000 |
| .5625 9/16 | .... | .... | .... | .... | .... | .... | .... | 14770 | .... | 16880 | .... | 18980 | .... | 21090 |
| .570 | .... | .... | .... | .... | .... | .... | .... | 14960 | .... | 17100 | .... | 19240 | .... | 21380 |
| .580 | .... | .... | .... | .... | .... | .... | .... | 15230 | .... | 17400 | .... | 19580 | .... | 21750 |
| .590 | .... | .... | .... | .... | .... | .... | .... | 15490 | .... | 17700 | .... | 19910 | .... | 22130 |
| .600 | .... | .... | .... | .... | .... | .... | .... | 15750 | .... | 18000 | .... | 20250 | .... | 22500 |
| .610 | .... | .... | .... | .... | .... | .... | .... | 16010 | .... | 18300 | .... | 20590 | .... | 22880 |
| .620 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 18600 | .... | 20930 | .... | 23250 |
| .625 5/8 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 18750 | .... | 21090 | .... | 23440 |
| .630 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 18900 | .... | 21260 | .... | 23630 |
| .640 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 19200 | .... | 21600 | .... | 24000 |
| .650 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 19500 | .... | 21940 | .... | 24380 |
| .660 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 19800 | .... | 22280 | .... | 24750 |
| .670 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 20100 | .... | 22610 | .... | 25130 |
| .680 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 20400 | .... | 22950 | .... | 25500 |
| .687 11/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 20630 | .... | 23200 | .... | 25780 |
| .690 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 20700 | .... | 23290 | .... | 25880 |
| .700 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 21000 | .... | 23630 | .... | 26250 |
| .710 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 23960 | .... | 26630 |
| .720 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 24300 | .... | 27000 |
| .730 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 24640 | .... | 27380 |
| .740 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 24980 | .... | 27750 |
| .750 3/4 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 25310 | .... | 28130 |
| .812 13/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 30470 |
| .875 7/8 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 32810 |
| .937 15/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1.00 1″ | 12000 | 15000 | 15000 | 18750 | 18000 | 22500 | 21000 | 26250 | 24000 | 30000 | 27000 | 33750 | 30000 | 37500 |

LOADS BY A. I. S. C. SPECIFICATION

| SHEAR @ 10000 | WORKING VALUES FOR HAND DRIVEN RIVETS AND UNFINISHED BOLTS | BEARING Single @ 16000 Double @ 20000 |
|---|---|---|

| Rivet dia. | ½″ | | ⅝″ | | ¾″ | | ⅞″ | | 1″ | | 1⅛″ | | 1¼″ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | 1963 | | .3068 | | .4418 | | .6013 | | .7854 | | .9940 | | 1 2272 | |
| Single Sh. | 1960 | | 3070 | | 4420 | | 6010 | | 7850 | | 9940 | | 12270 | |
| Double Sh | 3930 | | 6140 | | 8840 | | 12030 | | 15710 | | 19880 | | 24540 | |
| Thickness of Plate | Bearing | | Bearing | | Bearing | | Bearing | | Bearing | | Bearing | | Bearing | |
| | 16000 | 20000 | 16000 | 20000 | 16000 | 20000 | 16000 | 20000 | 16000 | 20000 | 16000 | 20000 | 16000 | 20000 |
| .170 | 1360 | 1700 | 1700 | 2130 | 2040 | 2550 | 2380 | 2980 | 2720 | 3400 | 3060 | 3830 | 3400 | 4250 |
| .180 | 1440 | 1800 | 1800 | 2250 | 2160 | 2700 | 2520 | 3150 | 2880 | 3600 | 3240 | 4050 | 3600 | 4500 |
| .1875 3/16 | 1500 | 1880 | 1880 | 2340 | 2250 | 2810 | 2630 | 3280 | 3000 | 3750 | 3380 | 4220 | 3750 | 4690 |
| .190 | 1520 | 1900 | 1900 | 2380 | 2280 | 2850 | 2660 | 3330 | 3040 | 3800 | 3420 | 4280 | 3800 | 4750 |
| .200 | 1600 | 2000 | 2000 | 2500 | 2400 | 3000 | 2800 | 3500 | 3200 | 4000 | 3600 | 4500 | 4000 | 5000 |
| .210 | 1680 | 2100 | 2100 | 2630 | 2520 | 3150 | 2940 | 3680 | 3360 | 4200 | 3780 | 4730 | 4200 | 5250 |
| .220 | 1760 | 2200 | 2200 | 2750 | 2640 | 3300 | 3080 | 3850 | 3520 | 4400 | 3960 | 4950 | 4400 | 5500 |
| .230 | 1840 | 2300 | 2300 | 2880 | 2760 | 3450 | 3220 | 4030 | 3680 | 4600 | 4140 | 5180 | 4600 | 5750 |
| .240 | 1920 | 2400 | 2400 | 3000 | 2880 | 3600 | 3360 | 4200 | 3840 | 4800 | 4320 | 5100 | 4800 | 6000 |
| .250 ¼ | .... | 2500 | 2500 | 3130 | 3000 | 3750 | 3500 | 4380 | 4000 | 5000 | 4500 | 5630 | 5000 | 6250 |
| .260 | .... | 2600 | 2600 | 3250 | 3120 | 3900 | 3640 | 4550 | 4160 | 5200 | 4680 | 5850 | 5200 | 6500 |
| .270 | .... | 2700 | 2700 | 3380 | 3240 | 4050 | 3780 | 4730 | 4320 | 5400 | 4860 | 6080 | 5400 | 6750 |
| .280 | .... | 2800 | 2800 | 3500 | 3360 | 4200 | 3920 | 4900 | 4480 | 5600 | 5040 | 6300 | 5600 | 7000 |
| .290 | .... | 2900 | 2900 | 3630 | 3480 | 4350 | 4060 | 5080 | 4640 | 5800 | 5220 | 6530 | 5800 | 7250 |
| .300 | .... | 3000 | 3000 | 3750 | 3600 | 4500 | 4200 | 5250 | 4800 | 6000 | 5400 | 6750 | 6000 | 7500 |
| .310 | .... | 3100 | .... | 3880 | 3720 | 4650 | 4340 | 5430 | 4960 | 6200 | 5580 | 6980 | 6200 | 7750 |
| .3125 5/16 | .... | 3130 | .... | 3910 | 3750 | 4690 | 4380 | 5470 | 5000 | 6250 | 5630 | 7030 | 6250 | 7810 |
| .320 | .... | 3200 | .... | 4000 | 3840 | 4800 | 4480 | 5600 | 5120 | 6400 | 5760 | 7200 | 6400 | 8000 |
| .330 | .... | 3300 | .... | 4130 | 3960 | 4950 | 4620 | 5780 | 5280 | 6600 | 5940 | 7430 | 6600 | 8250 |
| .340 | .... | 3400 | .... | 4250 | 4080 | 5100 | 4760 | 5950 | 5440 | 6800 | 6120 | 7650 | 6800 | 8500 |
| .350 | .... | 3500 | .... | 4380 | 4200 | 5250 | 4900 | 6130 | 5600 | 7000 | 6300 | 7880 | 7000 | 8750 |
| .360 | .... | 3600 | .... | 4500 | 4320 | 5400 | 5040 | 6300 | 5760 | 7200 | 6480 | 8100 | 7200 | 9000 |
| .370 | .... | 3700 | .... | 4630 | .... | 5550 | 5180 | 6480 | 5920 | 7400 | 6660 | 8330 | 7400 | 9250 |
| .375 ⅜ | .... | 3750 | .... | 4690 | .... | 5630 | 5250 | 6560 | 6000 | 7500 | 6750 | 8440 | 7500 | 9370 |
| .380 | .... | 3800 | .... | 4750 | .... | 5700 | 5320 | 6650 | 6080 | 7600 | 6840 | 8550 | 7600 | 9500 |
| .390 | .... | 3900 | .... | 4880 | .... | 5850 | 5460 | 6830 | 6240 | 7800 | 7020 | 8780 | 7800 | 9750 |
| .400 | .... | .... | .... | 5000 | .... | 6000 | 5600 | 7000 | 6400 | 8000 | 7200 | 9000 | 8000 | 10000 |
| .410 | .... | .... | .... | 5130 | .... | 6150 | 5740 | 7180 | 6560 | 8200 | 7380 | 9230 | 8200 | 10250 |
| .420 | .... | .... | .... | 5250 | .... | 6300 | 5880 | 7350 | 6720 | 8400 | 7560 | 9450 | 8400 | 10500 |
| .430 | .... | .... | .... | 5380 | .... | 6450 | .... | 7530 | 6880 | 8600 | 7740 | 9680 | 8600 | 10750 |
| .4375 7/16 | .... | .... | .... | 5470 | .... | 6560 | .... | 7660 | 7000 | 8750 | 7880 | 9840 | 8750 | 10940 |
| .440 | .... | .... | .... | 5500 | .... | 6600 | .... | 7700 | 7040 | 8800 | 7920 | 9900 | 8800 | 11000 |
| .450 | .... | .... | .... | 5630 | .... | 6750 | .... | 7880 | 7200 | 9000 | 8100 | 10130 | 9000 | 11250 |
| .460 | .... | .... | .... | 5750 | .... | 6900 | .... | 8050 | 7360 | 9200 | 8280 | 10350 | 9200 | 11500 |
| .470 | .... | .... | .... | 5880 | .... | 7050 | .... | 8230 | 7520 | 9400 | 8460 | 10580 | 9400 | 11750 |
| .480 | .... | .... | .... | 6000 | .... | 7200 | .... | 8400 | 7680 | 9600 | 8640 | 10800 | 9600 | 12000 |
| .490 | .... | .... | .... | 6130 | .... | 7350 | .... | 8580 | 7840 | 9800 | 8820 | 11030 | 9800 | 12250 |
| .500 ½ | .... | .... | .... | .... | .... | 7500 | .... | 8750 | .... | 10000 | 9000 | 11250 | 10000 | 12500 |
| .510 | .... | .... | .... | .... | .... | 7650 | .... | 8930 | .... | 10200 | 9180 | 11480 | 10200 | 12750 |
| .520 | .... | .... | .... | .... | .... | 7800 | .... | 9100 | .... | 10400 | 9360 | 11700 | 10400 | 13000 |
| .530 | .... | .... | .... | .... | .... | 7950 | .... | 9280 | .... | 10600 | 9540 | 11930 | 10600 | 13250 |
| .540 | .... | .... | .... | .... | .... | 8100 | .... | 9450 | .... | 10800 | 9720 | 12150 | 10800 | 13500 |
| .550 | .... | .... | .... | .... | .... | 8250 | .... | 9630 | .... | 11000 | 9900 | 12380 | 11000 | 13750 |
| .560 | .... | .... | .... | .... | .... | 8400 | .... | 9800 | .... | 11200 | .... | 12600 | 11200 | 14000 |
| .5625 9/16 | .... | .... | .... | .... | .... | 8440 | .... | 9850 | .... | 11250 | .... | 12660 | 11250 | 14060 |
| .570 | .... | .... | .... | .... | .... | 8550 | .... | 9980 | .... | 11400 | .... | 12830 | 11400 | 14250 |
| .580 | .... | .... | .... | .... | .... | 8700 | .... | 10150 | .... | 11600 | .... | 13050 | 11600 | 14500 |
| .590 | .... | .... | .... | .... | .... | .... | .... | 10330 | .... | 11800 | .... | 13280 | 11800 | 14750 |
| .600 | .... | .... | .... | .... | .... | .... | .... | 10500 | .... | 12000 | .... | 13500 | 12000 | 15000 |
| .610 | .... | .... | .... | .... | .... | .... | .... | 10680 | .... | 12200 | .... | 13730 | 12200 | 15250 |
| .620 | .... | .... | .... | .... | .... | .... | .... | 10850 | .... | 12400 | .... | 13950 | .... | 15500 |
| .625 ⅝ | .... | .... | .... | .... | .... | .... | .... | 10940 | .... | 12500 | .... | 14060 | .... | 15630 |
| .630 | .... | .... | .... | .... | .... | .... | .... | 11030 | .... | 12600 | .... | 14180 | .... | 15750 |
| .640 | .... | .... | .... | .... | .... | .... | .... | 11200 | .... | 12800 | .... | 14400 | .... | 16000 |
| .650 | .... | .... | .... | .... | .... | .... | .... | 11380 | .... | 13000 | .... | 14630 | .... | 16250 |
| .660 | .... | .... | .... | .... | .... | .... | .... | 11550 | .... | 13200 | .... | 14850 | .... | 16500 |
| .670 | .... | .... | .... | .... | .... | .... | .... | 11730 | .... | 13400 | .... | 15080 | .... | 16750 |
| .680 | .... | .... | .... | .... | .... | .... | .... | 11900 | .... | 13600 | .... | 15300 | .... | 17000 |
| .687 11/16 | .... | .... | .... | .... | .... | .... | .... | 12030 | .... | 13756 | .... | 15470 | .... | 17190 |
| .690 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 13800 | .... | 15530 | .... | 17250 |
| .700 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 14000 | .... | 15750 | .... | 17500 |
| .710 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 14200 | .... | 15980 | .... | 17750 |
| .720 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 14400 | .... | 16200 | .... | 18000 |
| .730 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 14600 | .... | 16430 | .... | 18250 |
| .740 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 14800 | .... | 16650 | .... | 18500 |
| .750 ¾ | .... | .... | .... | .... | .... | .... | .... | .... | .... | 15000 | .... | 16880 | .... | 18750 |
| .812 13/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 18280 | .... | 20310 |
| .875 ⅞ | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 19690 | .... | 21870 |
| .937 15/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 23440 |
| 1.00 1″ | 8000 | 10000 | 10000 | 12500 | 12000 | 15000 | 14000 | 17500 | 16000 | 20000 | 18000 | 22500 | 20000 | 25000 |

# WORKING VALUES FOR ONE ¾" POWER DRIVEN RIVET OR TURNED BOLT IN REAMED HOLE IN CHANNEL AND BEAM WEBS

Shear @ 13500 — Single Shear Bearing @ 24000 — Double Shear Bearing @ 30000

| Depth in Inches | Amer. Std. Channels | | | Amer. Std. Beams | | | Bethlehem Beams | | | Beth. Girder Beams | | | Carnegie Beam Sect. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear |
| 3 | 4.1 | 3060 | 3830 | 5.7 | 3060 | 3830 | | | | | | | | | |
| | 5.0 | 4640 | 5810 | 6.5 | 4520 | 5650 | | | | | | | | | |
| | 6.0 | 5960 | 8010 | 7.5 | 5960 | 7850 | | | | | | | | | |
| 4 | 5.4 | 3240 | 4050 | 7.7 | 3420 | 4280 | | | | | | | | | |
| | 6.25 | 4440 | 5560 | 8.5 | 4550 | 5690 | | | | | | | | | |
| | 7.25 | 5760 | 7200 | 9.5 | 5870 | 7340 | | | | | | | | | |
| | | | | 10.5 | 5960 | 9000 | | | | | | | | | |
| 5 | 6.7 | 3420 | 4280 | 10.0 | 3780 | 4730 | | | | | | | | | |
| | 9.0 | 5850 | 7310 | 12.25 | 5960 | 7810 | | | | | | | | | |
| | 11.5 | 5960 | 10620 | 14.75 | 5960 | 11120 | | | | | | | | | |
| 6 | 8.2 | 3600 | 4500 | 12.5 | 4140 | 5180 | | | | | | | | | |
| | 10.5 | 5650 | 7070 | 14.75 | 5960 | 7720 | | | | | | | | | |
| | 13.0 | 5960 | 9830 | 17.25 | 5960 | 10460 | | | | | | | | | |
| | 15.5 | 5960 | 11930 | | | | | | | | | | | | |
| 7 | 9.8 | 3780 | 4730 | 15.3 | 4500 | 5630 | | | | | | | | | |
| | 12.25 | 5650 | 7070 | 17.5 | 5960 | 7760 | | | | | | | | | |
| | 14.75 | 5960 | 9430 | 20.0 | 5960 | 10130 | | | | | | | | | |
| | 17.25 | 5960 | 11790 | | | | | | | | | | | | |
| | 19.75 | 5960 | 11930 | | | | | | | | | | | | |
| 8 | 11.50 | 3960 | 4950 | 18.4 | 4860 | 6080 | 17.5 | 4500 | 5630 | 29.5 | 5130 | 6410 | 24.0 | 4300 | 5380 |
| | 13.75 | 5450 | 6820 | 20.5 | 5960 | 7850 | 19.0 | 4860 | 6080 | 33.0 | 5220 | 6530 | 27.0 | 4830 | 6030 |
| | 16.25 | 5960 | 8890 | 23.0 | 5960 | 9920 | | | | 36.5 | 5580 | 6980 | 30.0 | 5364 | 6710 |
| | 18.75 | 5960 | 10960 | 25.5 | 5960 | 11930 | | | | | | | 31.0 | 5220 | 6530 |
| | 21.25 | 5960 | 11930 | | | | | | | | | | 36.0 | 5960 | 7560 |
| | | | | | | | | | | | | | 42.0 | 5960 | 8780 |
| 9 | 13.40 | 4140 | 5180 | 21.8 | 5220 | 6530 | 20.5 | 4500 | 5630 | 36.0 | 5220 | 6530 | 29.0 | 5020 | 6280 |
| | 15.0 | 5130 | 6410 | 25.0 | 5960 | 8930 | 22.0 | 4680 | 5850 | 38.5 | 5580 | 6980 | 32.0 | 5530 | 6910 |
| | 20.0 | 5960 | 10080 | 30.0 | 5960 | 11930 | | | | 43.5 | 5960 | 7880 | 35.0 | 5960 | 7540 |
| | 25.0 | 5960 | 11930 | 35.0 | 5960 | 11930 | | | | | | | 38.0 | 5690 | 7110 |
| | | | | | | | | | | | | | 43.0 | 5960 | 8030 |
| | | | | | | | | | | | | | 48.0 | 5960 | 8960 |
| 10 | 15.3 | 4320 | 5400 | 25.4 | 5580 | 6980 | 21.0 | 4320 | 5400 | 41.5 | 5580 | 6980 | 21.0 | 4140 | 5180 |
| | 20.0 | 5960 | 8530 | 30.0 | 5960 | 10060 | 23.5 | 4800 | 5630 | 44.5 | 5760 | 7200 | 23.0 | 4140 | 5180 |
| | 25.0 | 5960 | 11840 | 35.0 | 5960 | 11930 | 26.0 | 4860 | 6080 | 50.0 | 5960 | 8100 | 26.0 | 4660 | 5830 |
| | 30.0 | 5960 | 11930 | 40.0 | 5960 | 11930 | 28.5 | 5130 | 6410 | | | | 30.0 | 5364 | 6710 |
| | 35.0 | 5960 | 11930 | | | | | | | | | | 31.0 | 5760 | 7200 |
| | | | | | | | | | | | | | 36.0 | 5960 | 10510 |
| | | | | | | | | | | | | | 42.0 | 5960 | 11930 |
| | | | | | | | | | | | | | 49.0 | 5960 | 7880 |
| | | | | | | | | | | | | | 54.0 | 5960 | 11180 |
| | | | | | | | | | | | | | 59.0 | 5960 | 11930 |
| | | | | | | | | | | | | | 61.0 | 5960 | 11930 |
| 12 | 20.7 | 5040 | 6300 | 31.8 | 5960 | 7880 | 25.0 | 4320 | 5400 | 51.5 | 5960 | 8100 | 25.0 | 4320 | 5400 |
| | 25.0 | 5960 | 8710 | 35.0 | 5960 | 9630 | 28.0 | 4410 | 5510 | 55.5 | 5960 | 8550 | 28.0 | 4320 | 5400 |
| | 30.0 | 5960 | 11480 | 40.8 | 5960 | 10350 | 31.5 | 4860 | 6080 | 61.0 | 5960 | 9230 | 32.0 | 4930 | 6170 |
| | 35.0 | 5960 | 11930 | 45.0 | 5960 | 11930 | 36.0 | 5400 | 6750 | 66.6 | 5960 | 10130 | 34.0 | 5960 | 8440 |
| | 40.0 | 5960 | 11930 | 50.0 | 5960 | 11930 | 40.0 | 5940 | 7430 | 70.5 | 5960 | 10580 | 36.0 | 5540 | 6930 |
| | | | | 55.0 | 5960 | 11930 | 44.0 | 5960 | 8100 | 76.5 | 5960 | 11480 | 40.0 | 5220 | 6530 |
| | | | | | | | 48.5 | 5960 | 8890 | | | | 45.0 | 5870 | 7340 |
| | | | | | | | | | | | | | 50.0 | 6500 | 8120 |
| | | | | | | | | | | | | | 55.0 | 5960 | 8440 |
| | | | | | | | | | | | | | 60.0 | 5960 | 9200 |
| | | | | | | | | | | | | | 66.0 | 5960 | 10080 |
| | | | | | | | | | | | | | 65.0 | 5960 | 9000 |
| | | | | | | | | | | | | | 70.0 | 5960 | 11770 |
| | | | | | | | | | | | | | 76.0 | 5960 | 11930 |

# WORKING VALUES FOR ONE ¾" HAND DRIVEN RIVET OR UNFINISHED BOLT IN CHANNEL AND BEAM WEBS

Shear @ 10000 Single Shear Bearing @ 16000 Double Shear Bearing @ 20000

| Depth in Inches | Amer. Std. Channels | | | Amer. Std. Beams | | | Bethlehem Beams | | | Beth. Girder Beams | | | Carnegie Beam Sect. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear |
| 3 | 4.1 | 2040 | 2550 | 5.7 | 2040 | 2550 | | | | | | | | | |
| | 5.0 | 3100 | 3870 | 6.5 | 3010 | 3770 | | | | | | | | | |
| | 6.0 | 4270 | 5340 | 7.5 | 4190 | 5240 | | | | | | | | | |
| 4 | 5.4 | 2160 | 2700 | 7.7 | 2280 | 2850 | | | | | | | | | |
| | 6.25 | 2960 | 3710 | 8.5 | 3040 | 3800 | | | | | | | | | |
| | 7.25 | 3840 | 4800 | 9.5 | 3910 | 4890 | | | | | | | | | |
| | | | | 10.5 | 4420 | 6000 | | | | | | | | | |
| 5 | 6.7 | 2280 | 2850 | 10.0 | 2520 | 3150 | | | | | | | | | |
| | 9.0 | 3900 | 4880 | 12.25 | 4160 | 5210 | | | | | | | | | |
| | 11.5 | 4420 | 7080 | 14.75 | 4420 | 7410 | | | | | | | | | |
| 6 | 8.2 | 2400 | 3000 | 12.5 | 2760 | 3450 | | | | | | | | | |
| | 10.5 | 3770 | 4710 | 14.75 | 4120 | 5150 | | | | | | | | | |
| | 13.0 | 4420 | 6560 | 17.25 | 4420 | 6980 | | | | | | | | | |
| | 15.5 | 4420 | 8390 | | | | | | | | | | | | |
| 7 | 9.8 | 2520 | 3150 | 15.3 | 3000 | 3750 | | | | | | | | | |
| | 12.25 | 3770 | 4710 | 17.5 | 4140 | 5180 | | | | | | | | | |
| | 14.75 | 4420 | 6290 | 20.0 | 4420 | 6750 | | | | | | | | | |
| | 17.25 | 4420 | 7860 | | | | | | | | | | | | |
| | 19.75 | 4420 | 8840 | | | | | | | | | | | | |
| 8 | 11.50 | 2640 | 3300 | 18.4 | 3240 | 4050 | 17.5 | 3000 | 3750 | 29.5 | 3420 | 4280 | 24.0 | 2870 | 3590 |
| | 13.75 | 3640 | 4550 | 20.5 | 4190 | 5240 | 19.0 | 3240 | 4050 | 33.0 | 3480 | 4350 | 27.0 | 3220 | 4020 |
| | 16.25 | 4420 | 5930 | 23.0 | 4420 | 6620 | | | | 36.5 | 3720 | 4650 | 30.0 | 3580 | 4470 |
| | 18.75 | 4420 | 7310 | 25.5 | 4420 | 7980 | | | | | | | 31.0 | 3480 | 4350 |
| | 21.25 | 4420 | 8690 | | | | | | | | | | 36.0 | 4032 | 5040 |
| | | | | | | | | | | | | | 42.0 | 4420 | 5850 |
| 9 | 13.40 | 2760 | 3450 | 21.8 | 3480 | 4350 | 20.5 | 3000 | 3750 | 36.0 | 3480 | 4350 | 29.0 | 3350 | 4190 |
| | 15.0 | 3420 | 4280 | 25.0 | 4420 | 5960 | 22.0 | 3120 | 3900 | 38.5 | 3720 | 4650 | 32.0 | 3680 | 4610 |
| | 20.0 | 4420 | 6720 | 30.0 | 4420 | 8120 | | | | 43.5 | 4200 | 5250 | 35.0 | 4020 | 5030 |
| | 25.0 | 4420 | 8840 | 35.0 | 4420 | 8840 | | | | | | | 38.0 | 3790 | 4740 |
| | | | | | | | | | | | | | 43.0 | 4280 | 5360 |
| | | | | | | | | | | | | | 48.0 | 4420 | 5970 |
| 10 | 15.3 | 2880 | 3600 | 25.4 | 3720 | 4650 | 21.0 | 2880 | 3600 | 41.5 | 3720 | 4650 | 21.0 | 2760 | 3450 |
| | 20.0 | 4420 | 5690 | 30.0 | 4420 | 6710 | 23.5 | 3000 | 3750 | 44.5 | 3840 | 4800 | 23.0 | 2760 | 3450 |
| | 25.0 | 4420 | 7890 | 35.0 | 4420 | 8840 | 26.0 | 3240 | 4050 | 50.0 | 4320 | 5400 | 26.0 | 3110 | 3890 |
| | 30.0 | 4420 | 8840 | 40.0 | 4420 | 8840 | 28.5 | 3420 | 4280 | | | | 30.0 | 3580 | 4470 |
| | 35.0 | 4420 | 8840 | | | | | | | | | | 31.0 | 3840 | 4800 |
| | | | | | | | | | | | | | 36.0 | 4420 | 7010 |
| | | | | | | | | | | | | | 42.0 | 4420 | 8840 |
| | | | | | | | | | | | | | 49.0 | 4420 | 5250 |
| | | | | | | | | | | | | | 54.0 | 4420 | 7460 |
| | | | | | | | | | | | | | 59.0 | 4420 | 8840 |
| | | | | | | | | | | | | | 64.0 | 4420 | 8840 |
| 12 | 20.7 | 3360 | 4200 | 31.8 | 4200 | 5250 | 25.0 | 2880 | 3600 | 51.5 | 4320 | 5400 | 25.0 | 2880 | 3600 |
| | 25.0 | 4420 | 5810 | 35.0 | 4420 | 6420 | 28.0 | 2940 | 3680 | 55.5 | 4420 | 5700 | 28.0 | 2880 | 3600 |
| | 30.0 | 4420 | 7650 | 40.8 | 4420 | 6900 | 31.5 | 3240 | 4050 | 61.0 | 4420 | 6150 | 32.0 | 3290 | 4110 |
| | 35.0 | 4420 | 8840 | 45.0 | 4420 | 8480 | 36.0 | 3600 | 4500 | 66.0 | 4420 | 6750 | 34.0 | 4420 | 5630 |
| | 40.0 | 4420 | 8840 | 50.0 | 4420 | 8840 | 40.0 | 3960 | 4950 | 70.5 | 4420 | 7050 | 36.0 | 3700 | 4620 |
| | | | | 55.0 | 4420 | 8840 | 44.0 | 4320 | 5400 | 76.5 | 4420 | 7650 | 40.0 | 3480 | 4350 |
| | | | | | | | 48.5 | 4420 | 5930 | | | | 45.0 | 3910 | 4890 |
| | | | | | | | | | | | | | 50.0 | 4330 | 5420 |
| | | | | | | | | | | | | | 55.0 | 4420 | 5630 |
| | | | | | | | | | | | | | 60.0 | 4420 | 6140 |
| | | | | | | | | | | | | | 66.0 | 4420 | 6720 |
| | | | | | | | | | | | | | 65.0 | 4420 | 6000 |
| | | | | | | | | | | | | | 70.0 | 4420 | 7850 |
| | | | | | | | | | | | | | 76.0 | 4420 | 8840 |

# WORKING VALUES FOR ONE ¾" POWER DRIVEN RIVET OR TURNED BOLT IN REAMED HOLE IN CHANNEL AND BEAM WEBS

Shear @ 13500 Single Shear Bearing @ 24000 Double Shear Bearing @ 30000

| Depth in Inches | Amer. Std. Channels | | | Amer. Std. Beams | | | Bethlehem Beams | | | Beth. Girder Beams | | | Carnegie Beam Sect. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear |
| 14 | | | | | | | 30 0 | 4770 | 5960 | | | | 30.0 | 4860 | 6080 |
| | | | | | | | 33 0 | 4770 | 5960 | | | | 33.0 | 4860 | 6080 |
| | | | | | | | 37 5 | 5490 | 6860 | | | | 36.0 | 5290 | 6620 |
| | | | | | | | 42.0 | 5960 | 7650 | | | | 38.0 | 5960 | 8440 |
| | | | | | | | | | | | | | 39.0 | 5720 | 7160 |
| | | | | | | | | | | | | | 42.0 | 5960 | 7700 |
| | | | | | | | | | | | | | 48.0 | 5960 | 7720 |
| | | | | | | | | | | | | | 53.0 | 5960 | 8510 |
| | | | | | | | | | | | | | 58.0 | 5960 | 9290 |
| | | | | | | | | | | | | | 61.0 | 5960 | 8600 |
| | | | | | | | | | | | | | 68.0 | 5960 | 9560 |
| | | | | | | | | | | | | | 75.0 | 5960 | 10530 |
| | | | | | | | | | | | | | 85.0 | 5960 | 9790 |
| | | | | | | | | | | | | | 95.0 | 5960 | 10910 |
| | | | | | | | | | | | | | 105.0 | 5960 | 11930 |
| 15 | 33 9 | 5960 | 9000 | 42.9 | 5960 | 9230 | 36.0 | 5040 | 6300 | 64.5 | 5960 | 8780 | | | |
| | 35.0 | 5960 | 9500 | 45 0 | 5960 | 10170 | 38.5 | 5220 | 6530 | 69.0 | 5960 | 9450 | | | |
| | 40.0 | 5960 | 11700 | 50.0 | 5960 | 11930 | 40.0 | 5490 | 6860 | 74.0 | 5960 | 9900 | | | |
| | 45.0 | 5960 | 11930 | 55.0 | 5960 | 11930 | 42.5 | 5850 | 7310 | 80.5 | 5960 | 10800 | | | |
| | 50 0 | 5960 | 11930 | 60.8 | 5960 | 11930 | 46.0 | 5960 | 8210 | 94.0 | 5960 | 11930 | | | |
| | 55.0 | 5960 | 11930 | 65.0 | 5960 | 11930 | 50.5 | 5960 | 8660 | 99.0 | 5960 | 11930 | | | |
| | | | | 70.0 | 5960 | 11930 | 54.5 | 5960 | 9230 | 105.0 | 5960 | 11930 | | | |
| | | | | 75.0 | 5960 | 11930 | 59.5 | 5960 | 10130 | 111.0 | 5960 | 11930 | | | |
| | | | | | | | 71.5 | 5960 | 11700 | 127.0 | 5960 | 11930 | | | |
| | | | | | | | | | | 135.0 | 5960 | 11930 | | | |
| | | | | | | | | | | 141.0 | 5960 | 11930 | | | |
| | | | | | | | | | | 147.0 | 5960 | 11930 | | | |
| 16 | | | | | | | 35.0 | 5130 | 6410 | 74.5 | 5960 | 8780 | 35.0 | 5220 | 6530 |
| | | | | | | | 40.0 | 5310 | 6640 | 81.0 | 5960 | 9450 | 38.0 | 5650 | 7070 |
| | | | | | | | 45.0 | 5940 | 7425 | 87.0 | 5960 | 10130 | 40.0 | 5220 | 6530 |
| | | | | | | | 50.0 | 6059 | 8210 | 94.0 | 5960 | 10910 | 43.0 | 5960 | 8440 |
| | | | | | | | 56.5 | 5960 | 8440 | | | | 45.0 | 5870 | 7340 |
| | | | | | | | 60.5 | 5960 | 8780 | | | | 50.0 | 5960 | 8150 |
| | | | | | | | 66.0 | 5960 | 9450 | | | | 58.0 | 5960 | 8440 |
| | | | | | | | 71.5 | 5960 | 10240 | | | | 63.0 | 5960 | 9140 |
| | | | | | | | | | | | | | 68.0 | 5960 | 9860 |
| | | | | | | | | | | | | | 76.0 | 5960 | 9430 |
| | | | | | | | | | | | | | 83 0 | 5960 | 10310 |
| | | | | | | | | | | | | | 90.0 | 5960 | 11140 |
| | | | | | | | | | | | | | 100 0 | 5960 | 10446 |
| | | | | | | | | | | | | | 107 0 | 5960 | 11160 |
| | | | | | | | | | | | | | 115.0 | 5960 | 11930 |
| 18 | | | | 54 7 | 5960 | 10350 | 47.0 | 5850 | 7310 | 80 0 | 5960 | 9450 | 47.0 | 5760 | 7200 |
| | | | | 60.0 | 5960 | 11930 | 49.0 | 5940 | 7430 | 86 0 | 5960 | 9900 | 51.0 | 5960 | 8440 |
| | | | | 65 0 | 5960 | 11930 | 52.0 | 5960 | 7990 | 92.0 | 5960 | 10350 | 52.0 | 5960 | 7970 |
| | | | | 70 0 | 5960 | 11930 | 54.5 | 5960 | 8330 | 99.0 | 5960 | 10910 | 58 0 | 5960 | 8840 |
| | | | | 75.6 | 5960 | 11930 | 59.0 | 5960 | 8550 | | | | 67.0 | 5960 | 9140 |
| | | | | 80 0 | 5960 | 11930 | 64.5 | 5960 | 9000 | | | | 72.0 | 5960 | 9810 |
| | | | | 85 0 | 5960 | 11930 | 69.0 | 5960 | 9450 | | | | 78.0 | 5960 | 10600 |
| | | | | 90.0 | 5960 | 11930 | 74.0 | 5960 | 9900 | | | | 86.0 | 5960 | 9650 |
| | | | | | | | | | | | | | 93.0 | 5960 | 10420 |
| | | | | | | | | | | | | | 100.0 | 5960 | 11210 |
| 20 | | | | 65 4 | 5960 | 11250 | 56 0 | 5960 | 8440 | 99 0 | 5960 | 11480 | | | |
| | | | | 70.0 | 5960 | 11930 | 59.5 | 5960 | 8410 | 107.0 | 5960 | 11930 | | | |
| | | | | 75 0 | 5960 | 11930 | 62.0 | 5960 | 8780 | 113.0 | 5960 | 11930 | | | |
| | | | | 81.4 | 5960 | 11930 | 64.5 | 5960 | 9000 | 120.0 | 5960 | 11930 | | | |
| | | | | 85.0 | 5960 | 11930 | 68.5 | 5960 | 9230 | 127.0 | 5960 | 11930 | | | |
| | | | | 90.0 | 5960 | 11930 | 73.0 | 5960 | 9680 | 135.0 | 5960 | 11930 | | | |
| | | | | 95.0 | 5960 | 11930 | 78.0 | 5960 | 10350 | 142.0 | 5960 | 11930 | | | |
| | | | | 100.0 | 5960 | 11930 | | | | 149.0 | 5960 | 11930 | | | |

# WORKING VALUES FOR ONE ¾" HAND DRIVEN RIVET OR UNFINISHED BOLT IN CHANNEL AND BEAM WEBS

Shear @ 10000 Single Shear Bearing @ 16000 Double Shear Bearing @ 20000

| Depth in Inches | Amer. Std. Channels | | | Amer. Std. Beams | | | Bethlehem Beams | | | Beth. Girder Beams | | | Carnegie Beam Sect. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear |
| 14 | | | | | | | 30.0 | 3180 | 3980 | | | | 30.0 | 3240 | 4050 |
| | | | | | | | 33.0 | 3180 | 3980 | | | | 33.0 | 3240 | 4050 |
| | | | | | | | 37.5 | 3660 | 4580 | | | | 36.0 | 3530 | 4410 |
| | | | | | | | 42.0 | 4080 | 5100 | | | | 38.0 | 4420 | 5630 |
| | | | | | | | | | | | | | 39.0 | 3820 | 4770 |
| | | | | | | | | | | | | | 42.0 | 4100 | 5130 |
| | | | | | | | | | | | | | 48.0 | 4120 | 5150 |
| | | | | | | | | | | | | | 53.0 | 4420 | 5670 |
| | | | | | | | | | | | | | 58.0 | 4420 | 6200 |
| | | | | | | | | | | | | | 61.0 | 4420 | 5730 |
| | | | | | | | | | | | | | 68.0 | 4420 | 6380 |
| | | | | | | | | | | | | | 75.0 | 4420 | 7020 |
| | | | | | | | | | | | | | 85.0 | 4420 | 6530 |
| | | | | | | | | | | | | | 95.0 | 4420 | 7280 |
| | | | | | | | | | | | | | 105.0 | 4420 | 8040 |
| 15 | 33.9 | 4420 | 6000 | 42.9 | 4420 | 6150 | 36.0 | 3360 | 4200 | 64.5 | 4420 | 5850 | | | |
| | 35.0 | 4420 | 6330 | 45.0 | 4420 | 6780 | 38.5 | 3480 | 4350 | 69.0 | 4420 | 6300 | | | |
| | 40.0 | 4420 | 7800 | 50.0 | 4420 | 8250 | 40.0 | 3660 | 4580 | 74.0 | 4420 | 6600 | | | |
| | 45.0 | 4420 | 8840 | 55.0 | 4420 | 8840 | 42.5 | 3900 | 4880 | 80.5 | 4420 | 7200 | | | |
| | 50.0 | 4420 | 8840 | 60.8 | 4420 | 8840 | 46.0 | 4380 | 5480 | 94.0 | 4420 | 8100 | | | |
| | 55.0 | 4420 | 8840 | 65.0 | 4420 | 8840 | 50.5 | 4420 | 5780 | 99.0 | 4420 | 8550 | | | |
| | | | | 70.0 | 4420 | 8840 | 54.5 | 4420 | 6150 | 105.0 | 4420 | 8840 | | | |
| | | | | 75.0 | 4420 | 8840 | 59.5 | 4420 | 7560 | 111.0 | 4420 | 8840 | | | |
| | | | | | | | 71.5 | 4420 | 7800 | 127.0 | 4420 | 8840 | | | |
| | | | | | | | | | | 135.0 | 4420 | 8840 | | | |
| | | | | | | | | | | 141.0 | 4420 | 8840 | | | |
| | | | | | | | | | | 147.0 | 4420 | 8840 | | | |
| 16 | | | | | | | 35.0 | 3420 | 4280 | 74.5 | 4420 | 5850 | 35.0 | 3480 | 4350 |
| | | | | | | | 40.0 | 3540 | 4430 | 81.0 | 4420 | 6300 | 38.0 | 3770 | 4710 |
| | | | | | | | 45.0 | 3960 | 4950 | 87.0 | 4420 | 6750 | 40.0 | 3480 | 4350 |
| | | | | | | | 50.0 | 4380 | 5480 | 94.0 | 4420 | 7280 | 43.0 | 4420 | 5630 |
| | | | | | | | 56.5 | 4420 | 5630 | | | | 45.0 | 3910 | 4890 |
| | | | | | | | 60.5 | 4420 | 5850 | | | | 50.0 | 4340 | 5430 |
| | | | | | | | 66.0 | 4420 | 6300 | | | | 58.0 | 4420 | 5630 |
| | | | | | | | 71.5 | 4420 | 6830 | | | | 63.0 | 4420 | 6090 |
| | | | | | | | | | | | | | 68.0 | 4420 | 6570 |
| | | | | | | | | | | | | | 76.0 | 4420 | 6290 |
| | | | | | | | | | | | | | 83.0 | 4420 | 6870 |
| | | | | | | | | | | | | | 90.0 | 4420 | 7430 |
| | | | | | | | | | | | | | 100.0 | 4420 | 6960 |
| | | | | | | | | | | | | | 107.0 | 4420 | 7440 |
| | | | | | | | | | | | | | 115.0 | 4420 | 7980 |
| 18 | | | | 54.7 | 4420 | 6900 | 47.0 | 3900 | 4880 | 80.0 | 4420 | 6300 | 47.0 | 3840 | 4800 |
| | | | | 60.0 | 4420 | 8210 | 49.0 | 3960 | 4950 | 86.0 | 4420 | 6600 | 51.0 | 4420 | 5630 |
| | | | | 65.0 | 4420 | 8840 | 52.0 | 4260 | 5330 | 92.0 | 4420 | 6900 | 52.0 | 4250 | 5310 |
| | | | | 70.0 | 4420 | 8840 | 54.5 | 4420 | 5550 | 99.0 | 4420 | 7280 | 58.0 | 4420 | 5900 |
| | | | | 75.6 | 4420 | 8400 | 59.0 | 4420 | 5700 | | | | 67.0 | 4420 | 6090 |
| | | | | 80.0 | 4420 | 8840 | 64.5 | 4420 | 6000 | | | | 72.0 | 4420 | 6540 |
| | | | | 85.0 | 4420 | 8840 | 69.0 | 4420 | 6300 | | | | 78.0 | 4420 | 7070 |
| | | | | 90.0 | 4420 | 8840 | 74.0 | 4420 | 6600 | | | | 86.0 | 4420 | 6440 |
| | | | | | | | | | | | | | 93.0 | 4420 | 6950 |
| | | | | | | | | | | | | | 100.0 | 4420 | 7470 |
| 20 | | | | 65.4 | 4420 | 7500 | 56.0 | 4420 | 5630 | 99.0 | 4420 | 7650 | | | |
| | | | | 70.0 | 4420 | 8510 | 59.5 | 4420 | 5630 | 107.0 | 4420 | 8100 | | | |
| | | | | 75.0 | 4420 | 8840 | 62.0 | 4420 | 5850 | 113.0 | 4420 | 8400 | | | |
| | | | | 81.4 | 4420 | 8840 | 64.5 | 4420 | 6000 | 120.0 | 4420 | 8840 | | | |
| | | | | 85.0 | 4420 | 8840 | 68.5 | 4420 | 6150 | 127.0 | 4420 | 8840 | | | |
| | | | | 90.0 | 4420 | 8840 | 73.0 | 4420 | 6450 | 135.0 | 4420 | 8840 | | | |
| | | | | 95.0 | 4420 | 8840 | 78.0 | 4420 | 6900 | 142.0 | 4420 | 8840 | | | |
| | | | | 100.0 | 4420 | 8840 | | | | 149.0 | 4420 | 8840 | | | |

# WORKING VALUES FOR ONE ¾" POWER DRIVEN RIVET OR TURNED BOLT IN REAMED HOLE IN CHANNEL AND BEAM WEBS

Shear @ 13500 Single Shear Bearing @ 24000 Double Shear Bearing @ 30000

| Depth in Inches | Amer. Std. Beams | | | Bethlehem Beams | | | Beth. Girder Beams | | | Carnegie Beam Sect. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear |
| 21 | | | | | | | | | | 55.0 | 5960 | 8100 | 101.0 | 5969 | 10460 |
| | | | | | | | | | | 58.0 | 5960 | 8100 | 112.0 | 5960 | 11230 |
| | | | | | | | | | | 64.0 | 5960 | 8910 | 120.0 | 5960 | 11930 |
| | | | | | | | | | | 70.0 | 5960 | 9740 | 128.0 | 5960 | 11930 |
| | | | | | | | | | | 76.0 | 5960 | 10550 | 136.0 | 5960 | 11930 |
| | | | | | | | | | | 80.0 | 5960 | 9860 | | | |
| | | | | | | | | | | 86.0 | 5960 | 10580 | | | |
| | | | | | | | | | | 92.0 | 5960 | 11300 | | | |
| | | | | | | | | | | 98.0 | 5960 | 11930 | | | |
| 22 | | | | 54.5 | 5960 | 8100 | 101.0 | 5960 | 10130 | | | | | | |
| | | | | 58.0 | 5960 | 8100 | 108.0 | 5960 | 10800 | | | | | | |
| | | | | 62.5 | 5960 | 8830 | 116.0 | 5960 | 11480 | | | | | | |
| | | | | 67.5 | 5960 | 8780 | 124.0 | 5960 | 11930 | | | | | | |
| | | | | 73.0 | 5960 | 9340 | 132.0 | 5960 | 11930 | | | | | | |
| | | | | 77.0 | 5960 | 9860 | | | | | | | | | |
| | | | | 83.0 | 5960 | 10240 | | | | | | | | | |
| | | | | 89.0 | 5960 | 10910 | | | | | | | | | |
| | | | | 96.5 | 5960 | 11810 | | | | | | | | | |
| 24 | 79.9 | 5960 | 11250 | 70.0 | 5960 | 8890 | 107.0 | 5960 | 10910 | 70.0 | 5960 | 9000 | 130.0 | 5960 | 11930 |
| | 85.0 | 5960 | 11930 | 73.5 | 5960 | 8890 | 113.0 | 5960 | 11250 | 76.0 | 5960 | 9110 | 140.0 | 5960 | 11930 |
| | 90.0 | 5960 | 11930 | 79.5 | 5960 | 9680 | 120.0 | 5960 | 11930 | 85.0 | 5960 | 10170 | 150.0 | 5960 | 11930 |
| | 95.0 | 5960 | 11930 | 84.5 | 5960 | 10350 | 128.0 | 5960 | 11930 | 94.0 | 5960 | 11230 | 160.0 | 5960 | 11930 |
| | 100.0 | 5960 | 11930 | 90.5 | 5960 | 10690 | 132.0 | 5960 | 11930 | 100.0 | 5960 | 10130 | | | |
| | 105.9 | 5960 | 11930 | 95.5 | 5960 | 11360 | 140.0 | 5960 | 11930 | 110.0 | 5960 | 11120 | | | |
| | 110.0 | 5960 | 11930 | 99.5 | 5960 | 11810 | 148.0 | 5960 | 11930 | 120.0 | 5960 | 11930 | | | |
| | 115.0 | 5960 | 11930 | 104.5 | 5960 | 11930 | | | | | | | | | |
| | 120.0 | 5960 | 11930 | | | | | | | | | | | | |
| 26 | | | | 81.0 | 5960 | 9900 | 138.0 | 5960 | 11930 | | | | | | |
| | | | | 85.5 | 5960 | 10130 | 144.0 | 5960 | 11930 | | | | | | |
| | | | | 91.0 | 5960 | 10580 | 151.0 | 5960 | 11930 | | | | | | |
| | | | | 98.0 | 5960 | 11250 | 160.0 | 5960 | 11930 | | | | | | |
| 27 | | | | | | | | | | 85.0 | 5960 | 10370 | 145.0 | 5960 | 11930 |
| | | | | | | | | | | 91.0 | 5960 | 10370 | 160.0 | 5960 | 11930 |
| | | | | | | | | | | 101.0 | 5960 | 11480 | 175.0 | 5960 | 11930 |
| | | | | | | | | | | 112.0 | 5960 | 11930 | 190.0 | 5960 | 11930 |
| | | | | | | | | | | 124.0 | 5960 | 11930 | | | |
| | | | | | | | | | | 137.0 | 5960 | 11930 | | | |
| 28 | | | | 85.0 | 5960 | 10130 | 145.0 | 5960 | 11930 | | | | | | |
| | | | | 91.0 | 5960 | 10130 | 156.0 | 5960 | 11930 | | | | | | |
| | | | | 97.0 | 5960 | 10580 | 165.0 | 5960 | 11930 | | | | | | |
| | | | | 104.0 | 5960 | 11250 | 175.0 | 5960 | 11930 | | | | | | |
| | | | | 112.0 | 5960 | 11930 | 186.0 | 5960 | 11930 | | | | | | |
| | | | | 119.0 | 5960 | 11930 | | | | | | | | | |
| | | | | 133.0 | 5960 | 11930 | | | | | | | | | |
| 30 | | | | 110.0 | 5960 | 11700 | 173.0 | 5960 | 11930 | 115.0 | 5960 | 11930 | 180.0 | 5960 | 11930 |
| | | | | 115.0 | 5960 | 11930 | 180.0 | 5960 | 11930 | 126.0 | 5960 | 11930 | 200.0 | 5960 | 11930 |
| | | | | 121.0 | 5960 | 11930 | 190.0 | 5960 | 11930 | 138.0 | 5960 | 11930 | 220.0 | 5960 | 11930 |
| | | | | 129.0 | 5960 | 11930 | 200.0 | 5960 | 11930 | 151.0 | 5960 | 11930 | 240.0 | 5960 | 11930 |
| | | | | 137.0 | 5960 | 11930 | 220.0 | 5960 | 11930 | 165.0 | 5960 | 11930 | | | |
| | | | | 149.0 | 5960 | 11930 | 240.0 | 5960 | 11930 | | | | | | |
| | | | | 163.0 | 5960 | 11930 | | | | | | | | | |
| 33 | | | | 125.0 | 5960 | 11930 | 200.0 | 5960 | 11930 | 125.0 | 5960 | 11930 | 200.0 | 5960 | 11930 |
| | | | | 135.0 | 5960 | 11930 | 210.0 | 5960 | 11930 | 138.0 | 5960 | 11930 | 220.0 | 5960 | 11930 |
| | | | | 143.0 | 5960 | 11930 | 220.0 | 5960 | 11930 | 152.0 | 5960 | 11930 | 240.0 | 5960 | 11930 |
| | | | | 152.0 | 5960 | 11930 | 230.0 | 5960 | 11930 | 167.0 | 5960 | 11930 | 260.0 | 5960 | 11930 |
| | | | | 165.0 | 5960 | 11930 | 245.0 | 5960 | 11930 | | | | | | |
| | | | | | | | 260.0 | 5960 | 11930 | | | | | | |
| 36 | | | | 147.0 | 5960 | 11930 | 230.0 | 5960 | 11930 | 147.0 | 5960 | 11930 | 230.0 | 5960 | 11930 |
| | | | | 155.0 | 5960 | 11930 | 240.0 | 5960 | 11930 | 160.0 | 5960 | 11930 | 250.0 | 5960 | 11930 |
| | | | | 164.0 | 5960 | 11930 | 250.0 | 5960 | 11930 | 175.0 | 5960 | 11930 | 275.0 | 5960 | 11930 |
| | | | | 173.0 | 5960 | 11930 | 260.0 | 5960 | 11930 | 192.0 | 5960 | 11930 | 300.0 | 5960 | 11930 |
| | | | | 190.0 | 5960 | 11930 | 280.0 | 5960 | 11930 | | | | | | |
| | | | | | | | 300.0 | 5960 | 11930 | | | | | | |

# WORKING VALUES FOR ONE ¾" HAND DRIVEN RIVET OR UNFINISHED BOLT IN CHANNEL AND BEAM WEBS

Shear @ 10000 Single Shear Bearing @ 16000 Double Shear Bearing @ 20000

| Depth in Inches | Amer. Std. Beams | | | Bethlehem Beams | | | Beth. Girder Beams | | | Carnegie Beam Sect. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear | Weight Per Foot | Bearing Single Shear | Bearing Double Shear |
| 21 | | | | | | | | | | 55.0 | 4320 | 5400 | 104 0 | 4420 | 6980 |
| | | | | | | | | | | 58 0 | 4320 | 5400 | 112.0 | 4420 | 7490 |
| | | | | | | | | | | 64.0 | 4420 | 5940 | 120 0 | 4420 | 8030 |
| | | | | | | | | | | 70 0 | 4420 | 6500 | 128 0 | 4420 | 8550 |
| | | | | | | | | | | 76.0 | 4420 | 7050 | 136 0 | 4420 | 8840 |
| | | | | | | | | | | 80.0 | 4420 | 6570 | | | |
| | | | | | | | | | | 86.0 | 4420 | 7050 | | | |
| | | | | | | | | | | 92.0 | 4420 | 7530 | | | |
| | | | | | | | | | | 98.0 | 4420 | 8030 | | | |
| 22 | | | | 54.5 | 4320 | 5400 | 101.0 | 4420 | 6750 | | | | | | |
| | | | | 58.0 | 4320 | 5400 | 108.0 | 4420 | 7200 | | | | | | |
| | | | | 62.5 | 4420 | 5550 | 116.0 | 4420 | 7650 | | | | | | |
| | | | | 67.5 | 4420 | 5850 | 124 0 | 4420 | 8180 | | | | | | |
| | | | | 73.0 | 4420 | 6230 | 132 0 | 4420 | 8630 | | | | | | |
| | | | | 77.0 | 4420 | 6380 | | | | | | | | | |
| | | | | 83.0 | 4420 | 6830 | | | | | | | | | |
| | | | | 89.0 | 4420 | 7280 | | | | | | | | | |
| | | | | 96 5 | 4420 | 7880 | | | | | | | | | |
| 24 | 79.9 | 4420 | 7500 | 70 0 | 4420 | 5930 | 107.0 | 4420 | 7280 | 70 0 | 4420 | 6000 | 130.0 | 4420 | 8210 |
| | 85 0 | 4420 | 8440 | 73.5 | 4420 | 5930 | 113.0 | 4420 | 7500 | 76 0 | 4420 | 6080 | 140.0 | 4420 | 8820 |
| | 90 0 | 4420 | 8840 | 79.5 | 4420 | 6450 | 120 0 | 4420 | 7950 | 85.0 | 4420 | 6780 | 150 0 | 4420 | 8840 |
| | 95.0 | 4420 | 8840 | 84 5 | 4420 | 6900 | 128.0 | 4420 | 8550 | 94 0 | 4420 | 7490 | 160 0 | 4420 | 8840 |
| | 100.0 | 4420 | 8840 | 90.5 | 4420 | 7130 | 132 0 | 4420 | 7550 | 100 0 | 4420 | 6750 | | | |
| | 105.9 | 4420 | 8840 | 95 5 | 4420 | 7580 | 140 0 | 4420 | 8840 | 110 0 | 4420 | 7410 | | | |
| | 110.0 | 4420 | 8840 | 99.5 | 4420 | 7880 | 148 0 | 4420 | 8840 | 120 0 | 4420 | 8090 | | | |
| | 115.0 | 4420 | 8840 | 104.5 | 4420 | 8250 | | | | | | | | | |
| | 120.0 | 4420 | 8840 | | | | | | | | | | | | |
| 26 | | | | 81 0 | 4420 | 6600 | 138 0 | 4420 | 8700 | | | | | | |
| | | | | 85 5 | 4420 | 6750 | 144 0 | 4420 | 8840 | | | | | | |
| | | | | 91 0 | 4420 | 7050 | 151 0 | 4420 | 8840 | | | | | | |
| | | | | 98 0 | 4420 | 7500 | 160 0 | 4420 | 8840 | | | | | | |
| 27 | | | | | | | | | | 85 0 | 4420 | 6920 | 145 0 | 4420 | 8700 |
| | | | | | | | | | | 91.0 | 4420 | 6920 | 160 0 | 4420 | 8840 |
| | | | | | | | | | | 101 0 | 4420 | 7650 | 175.0 | 4420 | 8840 |
| | | | | | | | | | | 112 0 | 4420 | 8490 | 190 0 | 4420 | 8840 |
| | | | | | | | | | | 124 0 | 4420 | 8840 | | | |
| | | | | | | | | | | 137.0 | 4420 | 8840 | | | |
| 28 | | | | 85 0 | 4420 | 6750 | | | | | | | | | |
| | | | | 91 0 | 4420 | 6750 | 145 0 | 4420 | 8780 | | | | | | |
| | | | | 97 0 | 4420 | 7050 | 156 0 | 4420 | 8840 | | | | | | |
| | | | | 104 0 | 4420 | 7500 | 165 0 | 4420 | 8840 | | | | | | |
| | | | | 112.0 | 4420 | 8030 | 175 0 | 4420 | 8840 | | | | | | |
| | | | | 119 0 | 4420 | 8480 | 186 0 | 4420 | 8840 | | | | | | |
| | | | | 133 0 | 4420 | 8840 | | | | | | | | | |
| 30 | | | | 110 0 | 4420 | 7800 | 173.0 | 4420 | 8840 | 115.0 | 4420 | 7950 | 180.0 | 4420 | 8840 |
| | | | | 115 0 | 4420 | 7950 | 180.0 | 4420 | 8840 | 126.0 | 4420 | 8720 | 200 0 | 4420 | 8840 |
| | | | | 121 0 | 4420 | 8250 | 190.0 | 4420 | 8840 | 138.0 | 4420 | 8840 | 220 0 | 4420 | 8840 |
| | | | | 129 0 | 4420 | 8700 | 200.0 | 4420 | 8840 | 151.0 | 4420 | 8840 | 240 0 | 4420 | 8840 |
| | | | | 137.0 | 4420 | 8840 | 220.0 | 4420 | 8840 | 165.0 | 4420 | 8840 | | | |
| | | | | 149 0 | 4420 | 8840 | 240.0 | 4420 | 8840 | | | | | | |
| | | | | 163 0 | 4420 | 8840 | | | | | | | | | |
| 33 | | | | 125 0 | 4420 | 8100 | 200 0 | 4420 | 8840 | 125.0 | 4420 | 8840 | 200 0 | 4420 | 8840 |
| | | | | 135 0 | 4420 | 8700 | 210 0 | 4420 | 8840 | 138.0 | 4420 | 8840 | 220 0 | 4420 | 8840 |
| | | | | 143 0 | 4420 | 8840 | 220 0 | 4420 | 8840 | 152.0 | 4420 | 8840 | 240 0 | 4420 | 8840 |
| | | | | 152 0 | 4420 | 8840 | 230 0 | 4420 | 8840 | 167.0 | 4420 | 8840 | 260 0 | 4420 | 8840 |
| | | | | 165 0 | 4420 | 8840 | 245 0 | 4420 | 8840 | | | | | | |
| | | | | | | | 260 0 | 4420 | 8840 | | | | | | |
| 36 | | | | 147 0 | 4420 | 8840 | 230 0 | 4420 | 8840 | 147.0 | 4420 | 8840 | 230.0 | 4420 | 8840 |
| | | | | 155 0 | 4420 | 8840 | 240 0 | 4420 | 8840 | 160.0 | 4420 | 8840 | 250.0 | 4420 | 8840 |
| | | | | 164 0 | 4420 | 8840 | 250 0 | 4420 | 8840 | 175.0 | 4420 | 8840 | 275.0 | 4420 | 8840 |
| | | | | 173 0 | 4420 | 8840 | 260 0 | 4420 | 8840 | 192.0 | 4420 | 8840 | 300 0 | 4420 | 8840 |
| | | | | 190 0 | 4420 | 8840 | 280 0 | 4420 | 8840 | | | | | | |
| | | | | | | | 300 0 | 4420 | 8840 | | | | | | |

# DIMENSIONS, WEIGHTS AND CONVENTIONAL SIGNS FOR RIVETS

## DIMENSIONS OF RIVET HEADS (DRIVEN)

FORMULAE

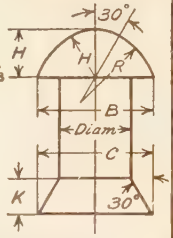
Diam. Head B = 1.5 D + 1/8

Height of Hd. H = .425 B

Long Rad. R = 1.5 H

Short Rad. = H

Depth of Countersink K = .5 D




| Diam of Rivet | BUTTON HEAD | | | COUNTERSUNK | |
|---|---|---|---|---|---|
| | Diam. B | Height H | Radius R | Diam. C | Height K |
| 3/8 | 11/16 | 5/16 | 7/16 | 9/16 | 3/16 |
| 1/2 | 7/8 | 3/8 | 9/16 | 3/4 | 1/4 |
| 5/8 | 1 1/16 | 7/16 | 11/16 | 1 | 5/16 |
| 3/4 | 1 1/4 | 1/2 | 13/16 | 1 3/16 | 3/8 |
| 7/8 | 1 7/16 | 5/8 | 15/16 | 1 3/8 | 7/16 |
| 1 | 1 5/8 | 11/16 | 1 | 1 9/16 | 1/2 |
| 1 1/8 | 1 13/16 | 3/4 | 1 1/8 | 1 3/4 | 9/16 |
| 1 1/4 | 2 | 7/8 | 1 1/4 | 2 | 5/8 |
| 1 3/8 | 2 3/16 | 15/16 | 1 3/8 | 2 3/16 | 11/16 |
| 1 1/2 | 2 3/8 | 1 | 1 1/2 | 2 3/8 | 3/4 |

## WEIGHTS OF 100 BUTTON HEAD STEEL RIVETS

| Length in Inches under Head | Diameter of Rivets in Inches | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1" | 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 |
| 1 | 4.8 | 10.0 | 17 | 28 | | | | | | |
| 1 1/4 | 5.6 | 11.4 | 20 | 31 | 44 | 60 | | | | |
| 1 1/2 | 6.4 | 12.7 | 22 | 34 | 48 | 65 | 87 | | | |
| 1 3/4 | 7.2 | 14.1 | 24 | 37 | 52 | 70 | 93 | | | |
| 2 | 7.9 | 15.5 | 26 | 40 | 56 | 75 | 100 | 133 | 167 | 206 |
| 2 1/4 | 8.7 | 16.9 | 28 | 43 | 60 | 81 | 107 | 141 | 177 | 218 |
| 2 1/2 | 9.5 | 18.3 | 30 | 46 | 64 | 86 | 114 | 149 | 187 | 230 |
| 2 3/4 | 10.3 | 19.7 | 33 | 49 | 69 | 91 | 120 | 158 | 197 | 242 |
| 3 | 11.1 | 21.0 | 35 | 52 | 73 | 96 | 127 | 166 | 208 | 254 |
| 3 1/4 | 11.9 | 22.4 | 37 | 55 | 77 | 102 | 134 | 174 | 218 | 266 |
| 3 1/2 | 12.6 | 23.8 | 39 | 58 | 81 | 107 | 141 | 183 | 228 | 278 |
| 3 3/4 | 13.4 | 25.2 | 41 | 62 | 85 | 112 | 148 | 191 | 238 | 290 |
| 4 | .... | 26.6 | 43 | 65 | 89 | 118 | 154 | 199 | 248 | 302 |
| 4 1/4 | .... | 28.0 | 46 | 68 | 93 | 123 | 161 | 208 | 258 | 314 |
| 4 1/2 | .... | 29.4 | 48 | 71 | 97 | 128 | 168 | 216 | 268 | 327 |
| 4 3/4 | .... | 30.7 | 50 | 74 | 101 | 133 | 175 | 224 | 278 | 339 |
| 5 | .... | 32.1 | 52 | 77 | 105 | 139 | 181 | 233 | 288 | 351 |
| 5 1/4 | .... | .... | 54 | 80 | 110 | 144 | 188 | 241 | 298 | 363 |
| 5 1/2 | .... | .... | 56 | 83 | 114 | 149 | 195 | 249 | 308 | 375 |
| 5 3/4 | .... | .... | 58 | 86 | 118 | 154 | 201 | 258 | 318 | 387 |
| 6 | .... | .... | 61 | 89 | 122 | 160 | 208 | 266 | 329 | 399 |
| 6 1/2 | .... | .... | .. | 95 | 130 | 170 | 222 | 283 | 349 | 423 |
| 7 | .... | .... | .. | 102 | 138 | 181 | 235 | 300 | 369 | 447 |
| 7 1/2 | .... | .... | .. | 108 | 146 | 191 | 249 | 316 | 389 | 471 |
| Weight of 100 Button Heads Only | 1.7 | 4.4 | 9 | 15 | 23 | 33 | 46 | 66 | 87 | 110 |

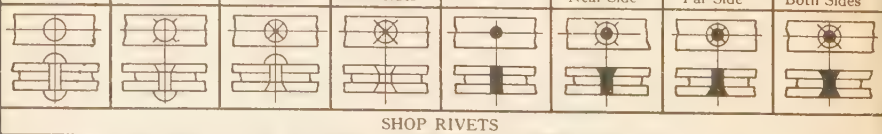
## CONVENTIONAL SIGNS FOR RIVETING

SHOP RIVETS

| Two Full Heads | Countersunk and Chipped | | |
|---|---|---|---|
| | Near Side | Far Side | Both Sides |

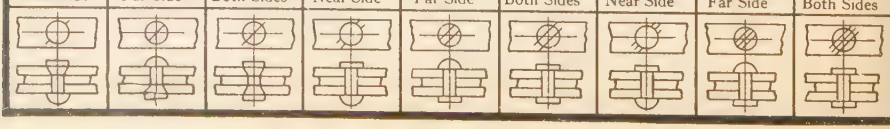
FIELD RIVETS

| Two Full Heads | Countersunk and Chipped | | |
|---|---|---|---|
| | Near Side | Far Side | Both Sides |



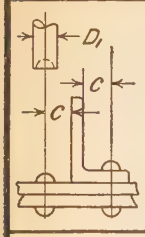
SHOP RIVETS

| Countersunk, Not Chipped, 1/8 High | | | Flattened, 1/4 High, 1/2 and 5/8 Rivets | | | Flattened, 3/8 High, 3/4 to 1" Rivets | | |
|---|---|---|---|---|---|---|---|---|
| Near Side | Far Side | Both Sides | Near Side | Far Side | Both Sides | Near Side | Far Side | Both Sides |



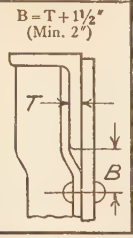
# RIVETING DETAILS

## DRIVING CLEARANCE




| Riv. Diam. | Die $D_1$ | Clear C |
|---|---|---|
| 3/8 | 1 1/2 | 7/8 |
| 1/2 | 1 3/4 | 1 |
| 5/8 | 2 | 1 1/8 |
| 3/4 | 2 1/4 | 1 1/4 |
| 7/8 | 2 1/2 | 1 3/8 |
| 1 | 2 3/4 | 1 1/2 |
| 1 1/8 | 3 | 1 5/8 |
| 1 1/4 | 3 1/4 | 1 3/4 |
| 1 3/8 | 3 1/2 | 1 7/8 |
| 1 1/2 | 3 3/4 | 2 |

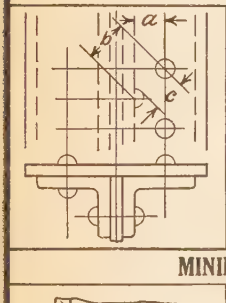
## CRIMPS




## GAGES FOR ANGLES

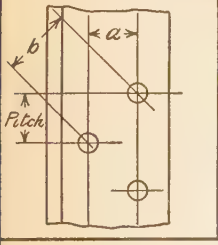
| Leg. | 1 3/4 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| g1 | 1 | 1 1/8 | 1 3/8 | 1 3/4 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 4 1/2 |
| g2 | ... | ... | ... | ... | ... | ... | 2 | 2 1/2 | 2 1/2 | 3 |
| g3 | ... | ... | ... | ... | ... | ... | 1 3/4 | 2 1/4 | 3 | 3 |
| Max. Riv | 1/2 | 5/8 | 3/4 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 1 | 1 1/8 |

## MINIMUM PITCH FOR MACHINE RIVETING




| Riv. Diam. D | Std. c | Std. b | a 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 | 1 5/8 | 1 3/4 | 1 7/8 | 2 | 2 1/8 | 2 1/4 | 2 3/8 | 2 1/2 | 2 3/4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/8 | 7/8 | 1 3/16 | 1/4 | 0 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1/2 | 1 | 1 3/8 | 3/4 | 1/2 | 0 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5/8 | 1 1/8 | 1 9/16 | 1 1/8 | 1 | 3/4 | 3/8 | 0 | ... | ... | ... | ... | ... | ... | ... | ... |
| 3/4 | 1 1/4 | 1 3/4 | ... | 1 1/4 | 1 1/8 | 1 | 3/4 | 0 | ... | ... | ... | ... | ... | ... | ... |
| 7/8 | 1 3/8 | 2 | ... | ... | 1 1/2 | 1 3/8 | 1 1/8 | 7/8 | 5/8 | 0 | ... | ... | ... | ... | ... |
| 1 | 1 1/2 | 2 3/16 | ... | ... | ... | 1 5/8 | 1 1/2 | 1 3/8 | 1 1/8 | 7/8 | 1/2 | 0 | ... | ... | ... |
| 1 1/8 | 1 5/8 | 2 3/8 | ... | ... | ... | ... | 1 3/4 | 1 5/8 | 1 1/2 | 1 3/8 | 1 1/8 | 7/8 | 0 | ... | ... |
| 1 1/4 | 1 3/4 | 2 5/8 | ... | ... | ... | ... | ... | 2 | 1 7/8 | 1 3/4 | 1 1/2 | 1 1/4 | 1 | 5/8 | 0 |
| 1 3/8 | 1 7/8 | 2 13/16 | ... | ... | ... | ... | ... | ... | 2 1/8 | 2 | 1 7/8 | 1 3/4 | 1 1/2 | 1 1/4 | 1/2 |
| 1 1/2 | 2 | 3 | ... | ... | ... | ... | ... | ... | ... | 2 1/4 | 2 1/8 | 2 | 1 7/8 | 1 5/8 | 1 1/8 |

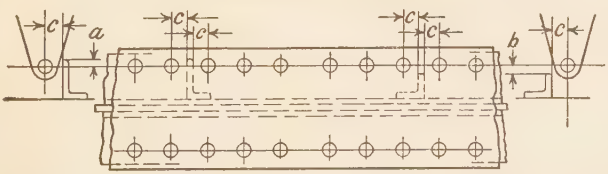
## MINIMUM PITCH TO MAINTAIN 3 DIAMETERS C TO C




| Riv. Diam. D | Min. CtoC b | a 1 | 1 1/4 | 1 1/2 | 1 3/4 | 2 | 2 1/4 | 2 1/2 | 2 3/4 | 3 | 3 1/4 | 3 1/2 | 3 3/4 | 4 | 4 1/4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/8 | 1 1/8 | 1/2 | 0 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1/2 | 1 1/2 | 1 1/8 | 7/8 | 0 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5/8 | 1 7/8 | 1 5/8 | 1 3/8 | 1 1/8 | 5/8 | 0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 3/4 | 2 1/4 | 2 | 1 7/8 | 1 5/8 | 1 3/8 | 1 | 0 | ... | ... | ... | ... | ... | ... | ... | ... |
| 7/8 | 2 5/8 | 2 1/2 | 2 3/8 | 2 1/8 | 2 | 1 3/4 | 1 3/8 | 3/4 | 0 | ... | ... | ... | ... | ... | ... |
| 1 | 3 | 2 7/8 | 2 3/4 | 2 5/8 | 2 1/2 | 2 1/4 | 2 | 1 5/8 | 1 1/8 | 0 | ... | ... | ... | ... | ... |
| 1 1/8 | 3 3/8 | 3 1/4 | 3 1/4 | 3 | 2 7/8 | 2 3/4 | 2 1/2 | 2 1/4 | 2 | 1 1/2 | 7/8 | 0 | ... | ... | ... |
| 1 1/4 | 3 3/4 | 3 5/8 | 3 1/2 | 3 3/8 | 3 3/8 | 3 1/4 | 3 | 2 3/4 | 2 1/2 | 2 1/4 | 1 7/8 | 1 3/8 | 0 | ... | ... |
| 1 3/8 | 4 1/8 | 4 | 4 | 3 7/8 | 3 3/4 | 3 5/8 | 3 1/2 | 3 1/4 | 3 1/8 | 2 7/8 | 2 1/2 | 2 1/8 | 1 3/4 | 1 | 0 |
| 1 1/2 | 4 1/2 | 4 3/8 | 4 3/8 | 4 1/4 | 4 1/8 | 4 | 3 7/8 | 3 3/4 | 3 1/2 | 3 3/8 | 3 1/8 | 2 7/8 | 2 1/2 | 2 | 1 1/2 |

## COVER PLATE RIVETING

| a | c |
|---|---|
| 1/2 | 2 1/2 |
| 1 | 2 5/8 |
| 1 1/2 | 2 3/4 |
| 2 | 2 3/4 |
| 2 1/2 | 2 7/8 |
| 3 | 2 7/8 |
| 3 1/2 | 3 |
| 4 | 3 1/8 |
| 5 | 3 1/4 |
| 6 | 3 3/8 |

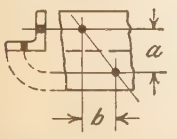



The use of hand pneumatic hammers is avoided where construction permits these clearances.

| b | c |
|---|---|
| ... | 2 1/2 |
| 1/2 | 2 3/8 |
| 3/4 | 2 1/4 |
| 1 | 2 1/4 |
| 1 1/4 | 2 1/8 |
| 1 1/2 | 2 |
| 1 3/4 | 1 3/4 |
| 2 | 1 1/2 |
| 2 1/4 | 1 |
| 2 1/2 | ... |

## STAGGER OF RIVETS TO MAINTAIN NET SECTION

1 Hole Out




2 Holes Out

5/8" rivets, can be taken at 1/8" less than for 3/4".
1" rivets, can be taken at 1/8" more than for 7/8".

| a | 3/4 Rivet b | 7/8 Rivet b | $a_1$ | 3/4 Rivet b | 7/8 Rivet b |
|---|---|---|---|---|---|
| 1 | 1 5/8 | 1 3/4 | 5 | 3 1/16 | 3 5/16 |
| 1 1/2 | 1 7/8 | 2 | 5 1/2 | 3 1/4 | 3 1/2 |
| 2 | 2 1/16 | 2 1/4 | 6 | 3 3/8 | 3 5/8 |
| 2 1/2 | 2 1/4 | 2 7/16 | 6 1/2 | 3 1/2 | 3 3/4 |
| 3 | 2 7/16 | 2 5/8 | 7 | 3 5/8 | 3 7/8 |
| 3 1/2 | 2 9/16 | 2 13/16 | 7 1/2 | 3 3/4 | 4 |
| 4 | 2 13/16 | 3 | 8 | 3 7/8 | 4 1/8 |
| 4 1/2 | 2 15/16 | 3 3/16 | 8 1/2 | 4 | 4 1/4 |

# LENGTHS OF UNDRIVEN RIVETS FOR VARIOUS LENGTHS OF GRIP

## BUTTON HEAD

| Grip | Diameter of Rivet | | | | | | |
|---|---|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ⅞ | 1″ | 1¼ | 1½ |
| ½ | 1 5/8 | 1 3/4 | 1 7/8 | 2 | 2 1/8 | | |
| ⅝ | 1 3/4 | 1 7/8 | 2 | 2 1/8 | 2 1/4 | | |
| ¾ | 1 7/8 | 2 | 2 1/8 | 2 1/4 | 2 3/8 | | |
| ⅞ | 2 | 2 1/8 | 2 1/4 | 2 3/8 | 2 1/2 | | |
| 1 | 2 1/4 | 2 3/8 | 2 3/8 | 2 1/2 | 2 5/8 | 2 7/8 | 3 1/8 |
| 1⅛ | 2 3/8 | 2 1/2 | 2 1/2 | 2 5/8 | 2 3/4 | 3 | 3 1/4 |
| 1¼ | 2 1/2 | 2 5/8 | 2 5/8 | 2 3/4 | 2 7/8 | 3 1/8 | 3 3/8 |
| 1⅜ | 2 5/8 | 2 3/4 | 2 3/4 | 2 7/8 | 3 | 3 1/4 | 3 1/2 |
| 1½ | 2 7/8 | 2 7/8 | 3 | 3 1/8 | 3 1/4 | 3 3/8 | 3 5/8 |
| 1⅝ | 3 | 3 | 3 1/8 | 3 1/4 | 3 3/8 | 3 1/2 | 3 3/4 |
| 1¾ | 3 1/8 | 3 1/4 | 3 1/4 | 3 3/8 | 3 1/2 | 3 5/8 | 3 7/8 |
| ⅞ | 3 1/4 | 3 3/8 | 3 3/8 | 3 5/8 | 3 5/8 | 3 7/8 | 4 |
| 2 | 3 1/2 | 3 1/2 | 3 5/8 | 3 3/4 | 3 3/4 | 4 | 4 1/4 |
| 1⅛ | 3 5/8 | 3 5/8 | 3 3/4 | 3 7/8 | 3 7/8 | 4 1/8 | 4 3/8 |
| 1¼ | 3 3/4 | 3 7/8 | 3 7/8 | 4 | 4 1/8 | 4 1/4 | 4 1/2 |
| 1⅜ | 4 | 4 | 4 | 4 1/8 | 4 1/4 | 4 3/8 | 4 5/8 |
| 1½ | 4 1/8 | 4 1/8 | 4 1/8 | 4 1/4 | 4 3/8 | 4 1/2 | 4 3/4 |
| 1⅝ | 4 1/4 | 4 1/4 | 4 1/4 | 4 3/8 | 4 1/2 | 4 5/8 | 4 7/8 |
| 1¾ | 4 3/8 | 4 3/8 | 4 3/8 | 4 1/2 | 4 5/8 | 4 3/4 | 5 |
| ⅞ | 4 5/8 | 4 5/8 | 4 5/8 | 4 5/8 | 4 3/4 | 4 7/8 | 5 1/8 |
| 3 | . . | 4 3/4 | 4 3/4 | 4 7/8 | 4 7/8 | 5 1/8 | 5 1/4 |
| 1⅛ | . . | 4 7/8 | 4 7/8 | 5 | 5 1/8 | 5 1/4 | 5 3/8 |
| 1¼ | . . | 5 | 5 | 5 1/8 | 5 1/4 | 5 3/8 | 5 1/2 |
| 1⅜ | . . | 5 1/8 | 5 1/8 | 5 1/4 | 5 3/8 | 5 1/2 | 5 5/8 |
| 1½ | . . | 5 3/8 | 5 3/8 | 5 3/8 | 5 1/2 | 5 5/8 | 5 3/4 |
| 1⅝ | . . | 5 1/2 | 5 1/2 | 5 1/2 | 5 5/8 | 5 3/4 | 6 |
| 1¾ | . . | 5 5/8 | 5 5/8 | 5 5/8 | 5 3/4 | 5 7/8 | 6 1/8 |
| ⅞ | . . | 5 3/4 | 5 3/4 | 5 3/4 | 5 7/8 | 6 | 6 1/4 |
| 4 | . . . | . . | 5 7/8 | 6 | 6 | 6 1/8 | 6 3/8 |
| 1⅛ | . . . | . . | 6 | 6 1/8 | 6 1/4 | 6 1/4 | 6 1/2 |
| 1¼ | . . . | . . | 6 1/8 | 6 1/4 | 6 3/8 | 6 3/8 | 6 5/8 |
| 1⅜ | . . . | . . | 6 3/8 | 6 1/2 | 6 1/2 | 6 5/8 | 6 3/4 |
| 1½ | . . . | . . | 6 1/2 | 6 5/8 | 6 5/8 | 6 3/4 | 6 7/8 |
| 1⅝ | . . . | . . | 6 5/8 | 6 3/4 | 6 3/4 | 6 7/8 | 7 |
| 1¾ | . . . | . . | 6 3/4 | 6 7/8 | 6 7/8 | 7 | 7 1/8 |
| ⅞ | . . . | . . | 6 7/8 | 7 | 7 | 7 1/8 | 7 1/4 |
| 5 | . . . | . . . | . . | 7 1/8 | 7 1/8 | 7 1/4 | 7 1/2 |
| 1⅛ | . . . | . . . | . . | 7 1/4 | 7 1/4 | 7 3/8 | 7 5/8 |
| 1¼ | . . . | . . . | . . | 7 3/8 | 7 3/8 | 7 1/2 | 7 3/4 |
| 1⅜ | . . . | . . . | . . | 7 5/8 | 7 5/8 | 7 3/4 | 7 7/8 |
| 1½ | . . . | . . . | . . | 7 3/4 | 7 3/4 | 7 7/8 | 8 |
| 1⅝ | . . . | . . . | . . | 7 7/8 | 7 7/8 | 8 | 8 1/8 |
| 1¾ | . . . | . . . | . . | 8 | 8 | 8 1/8 | 8 1/4 |
| ⅞ | . . . | . . . | . . | 8 1/8 | 8 1/8 | 8 1/4 | 8 3/8 |
| 6 | . . . | . . . | . . | 8 3/8 | 8 3/8 | 8 3/8 | 8 1/2 |
| 1⅛ | . . . | . . . | . . | 8 1/2 | 8 1/2 | 8 1/2 | 8 5/8 |
| 1¼ | . . . | . . . | . . | 8 5/8 | 8 5/8 | 8 5/8 | 8 3/4 |
| 1⅜ | . . . | . . . | . . | 8 3/4 | 8 3/4 | 9 | |
| 1½ | . . . | . . . | . . | 8 7/8 | 8 7/8 | 8 7/8 | 9 1/8 |
| 1⅝ | . . . | . . . | . . | 9 | 9 | 9 1/8 | 9 1/4 |
| 1¾ | . . . | . . . | . . | 9 1/8 | 9 1/8 | 9 1/4 | 9 3/8 |
| ⅞ | . . . | . . . | . . | 9 1/4 | 9 1/4 | 9 3/8 | 9 1/2 |
| 7 | . . . | . . . | . . | . . | 9 3/8 | 9 1/2 | 9 5/8 |
| 1⅛ | . . . | . . . | . . | . . | 9 5/8 | 9 5/8 | 9 3/4 |
| 1¼ | . . . | . . . | . . | . . | 9 3/4 | 9 3/4 | 9 7/8 |
| 1⅜ | . . . | . . . | . . | . . | 9 7/8 | 9 7/8 | 10 |
| 1½ | . . . | . . . | . . | . . | 10 | 10 | 10 1/8 |
| 1⅝ | . . . | . . . | . . | . . | 10 1/8 | 10 1/8 | 10 1/4 |
| 1¾ | . . . | . . . | . . | . . | 10 1/4 | 10 3/8 | 10 1/2 |
| ⅞ | . . . | . . . | . . | . . | 10 3/8 | 10 1/2 | 10 5/8 |

## COUNTERSUNK

| Grip | Diameter of Rivet | | | | | | |
|---|---|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ⅞ | 1″ | 1¼ | 1½ |
| ½ | 1 | 1 | 1 1/8 | 1 1/4 | 1 1/4 | | |
| ⅝ | 1 1/8 | 1 1/4 | 1 1/4 | 1 3/8 | 1 3/8 | | |
| ¾ | 1 3/8 | 1 3/8 | 1 3/8 | 1 1/2 | 1 1/2 | | |
| ⅞ | 1 1/2 | 1 1/2 | 1 1/2 | 1 5/8 | 1 5/8 | | |
| 1 | 1 5/8 | 1 5/8 | 1 5/8 | 1 3/4 | 1 3/4 | 1 7/8 | 2 |
| 1⅛ | 1 3/4 | 1 3/4 | 1 7/8 | 1 7/8 | 1 7/8 | 2 | 2 1/8 |
| 1¼ | 2 | 2 | 2 | 2 | 2 | 2 1/8 | 2 1/4 |
| 1⅜ | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/4 | 2 1/4 | 2 3/8 | 2 1/2 |
| 1½ | 2 1/4 | 2 1/4 | 2 1/4 | 2 3/8 | 2 3/8 | 2 1/2 | 2 5/8 |
| 1⅝ | 2 3/8 | 2 3/8 | 2 3/8 | 2 1/2 | 2 1/2 | 2 5/8 | 2 3/4 |
| 1¾ | 2 5/8 | 2 5/8 | 2 5/8 | 2 5/8 | 2 5/8 | 2 3/4 | 2 7/8 |
| ⅞ | 2 3/4 | 2 3/4 | 2 3/4 | 2 3/4 | 2 3/4 | 2 7/8 | 3 |
| 2 | 2 7/8 | 2 7/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 | 3 1/8 |
| 1⅛ | 3 1/8 | 3 | 3 | 3 | 3 | 3 1/8 | 3 1/4 |
| 1¼ | 3 1/4 | 3 1/8 | 3 1/8 | 3 1/8 | 3 1/8 | 3 1/4 | 3 3/8 |
| 1⅜ | 3 3/8 | 3 3/8 | 3 3/8 | 3 3/8 | 3 3/8 | 3 3/8 | 3 1/2 |
| 1½ | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2 | 3 5/8 | 3 5/8 |
| 1⅝ | 3 3/4 | 3 5/8 | 3 5/8 | 3 5/8 | 3 5/8 | 3 3/4 | 3 3/4 |
| 1¾ | 3 7/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 3/4 | 3 7/8 | 4 |
| ⅞ | 4 | 3 7/8 | 3 7/8 | 3 7/8 | 3 7/8 | 4 | 4 1/8 |
| 3 | . | 4 1/8 | 4 1/8 | 4 1/8 | 4 1/8 | 4 1/8 | 4 1/4 |
| 1⅛ | . | 4 1/4 | 4 1/4 | 4 1/4 | 4 1/4 | 4 1/4 | 4 3/8 |
| 1¼ | . | 4 3/8 | 4 3/8 | 4 3/8 | 4 3/8 | 4 3/8 | 4 1/2 |
| 1⅜ | . | 4 1/2 | 4 1/2 | 4 1/2 | 4 1/2 | 4 1/2 | 4 5/8 |
| 1½ | . | 4 5/8 | 4 5/8 | 4 5/8 | 4 5/8 | 4 5/8 | 4 3/4 |
| 1⅝ | . | 4 3/4 | 4 3/4 | 4 3/4 | 4 3/4 | 4 7/8 | 4 7/8 |
| 1¾ | . | 5 | 5 | 5 | 5 | 5 | 5 |
| ⅞ | . | 5 1/8 | 5 1/8 | 5 1/8 | 5 1/8 | 5 1/8 | 5 1/8 |
| 4 | . . | . | 5 1/4 | 5 1/4 | 5 1/4 | 5 1/4 | 5 1/4 |
| 1⅛ | . . | . | 5 3/8 | 5 3/8 | 5 3/8 | 5 3/8 | 5 1/2 |
| 1¼ | . . | . | 5 1/2 | 5 1/2 | 5 1/2 | 5 1/2 | 5 5/8 |
| 1⅜ | . . | . | 5 5/8 | 5 5/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 1½ | . . | . | 5 3/4 | 5 3/4 | 5 3/4 | 5 3/4 | 5 7/8 |
| 1⅝ | . . | . | 6 | 6 | 6 | 6 | 6 |
| 1¾ | . . | . | 6 1/8 | 6 1/8 | 6 1/8 | 6 1/8 | 6 1/8 |
| ⅞ | . . | . | 6 1/4 | 6 1/4 | 6 1/4 | 6 1/4 | 6 1/4 |
| 5 | . . | . . | . | 6 3/8 | 6 3/8 | 6 3/8 | 6 3/8 |
| 1⅛ | . . | . . | . | 6 1/2 | 6 1/2 | 6 1/2 | 6 1/2 |
| 1¼ | . . | . . | . | 6 5/8 | 6 5/8 | 6 5/8 | 6 5/8 |
| 1⅜ | . . | . . | . | 6 3/4 | 6 3/4 | 6 3/4 | 6 7/8 |
| 1½ | . . | . . | . | 6 7/8 | 6 7/8 | 6 7/8 | 7 |
| 1⅝ | . . | . . | . | 7 | 7 | 7 | 7 1/8 |
| 1¾ | . . | . . | . | 7 1/4 | 7 1/4 | 7 1/4 | 7 1/4 |
| ⅞ | . . | . . | . | 7 3/8 | 7 3/8 | 7 3/8 | 7 3/8 |
| 6 | . . | . . | . | 7 1/2 | 7 1/2 | 7 1/2 | 7 1/2 |
| 1⅛ | . . | . . | . | 7 5/8 | 7 5/8 | 7 5/8 | 7 5/8 |
| 1¼ | . . | . . | . | 7 3/4 | 7 3/4 | 7 3/4 | 7 3/4 |
| 1⅜ | . . | . . | . | 7 7/8 | 7 7/8 | 7 7/8 | 7 7/8 |
| 1½ | . . | . . | . | 8 | 8 | 8 | 8 |
| 1⅝ | . . | . . | . | 8 1/4 | 8 1/4 | 8 1/4 | 8 1/4 |
| 1¾ | . . | . . | . | 8 3/8 | 8 3/8 | 8 3/8 | 8 3/8 |
| ⅞ | . . | . . | . | 8 1/2 | 8 1/2 | 8 1/2 | 8 1/2 |
| 7 | . . | . . | . | . . | 8 5/8 | 8 5/8 | 8 5/8 |
| 1⅛ | . . | . . | . | . . | 8 3/4 | 8 3/4 | 8 3/4 |
| 1¼ | . . | . . | . | . . | 8 7/8 | 8 7/8 | 8 7/8 |
| 1⅜ | . . | . . | . | . . | 9 | 9 | 9 |
| 1½ | . . | . . | . | . . | 9 1/8 | 9 1/8 | 9 1/8 |
| 1⅝ | . . | . . | . | . . | 9 1/4 | 9 1/4 | 9 1/4 |
| 1¾ | . . | . . | . | . . | 9 3/8 | 9 3/8 | 9 3/8 |
| ⅞ | . . | . . | . | . . | 9 1/2 | 9 1/2 | 9 1/2 |

For 1⅛″ Rivets use lengths given above for 1¼″, and for 1⅜″ Rivets those given for 1½″.

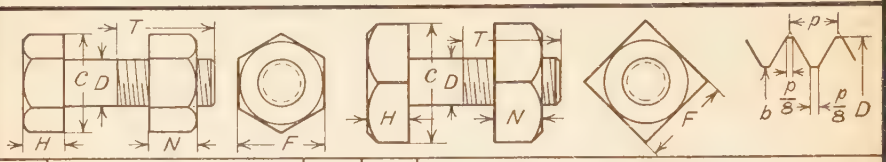
# REDUCTION OF AREA IN PLATES FOR RIVET HOLES

| Thickness of Plate | | DIAMETER OF HOLE IN INCHES | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1″ | 1 1/16 | 1 1/8 | 1 3/16 |
| .170 | | .043 | .053 | .064 | .074 | .085 | .096 | .106 | .117 | .128 | .138 | .149 | .159 | .170 | .181 | .191 | .202 |
| .180 | | .045 | .056 | .068 | .079 | .090 | .101 | .113 | .124 | .135 | .146 | .158 | .169 | .180 | .191 | .203 | .214 |
| .1875 | 3/16 | .047 | .059 | .070 | .082 | .094 | .105 | .117 | .129 | .141 | .152 | .164 | .176 | .188 | .199 | .211 | .223 |
| .190 | | .048 | .059 | .071 | .083 | .095 | .107 | .119 | .131 | .143 | .154 | .166 | .178 | .190 | .202 | .214 | .226 |
| .200 | | .050 | .063 | .075 | .088 | .100 | .113 | .125 | .138 | .150 | .163 | .175 | .188 | .200 | .213 | .225 | .238 |
| .210 | | .053 | .066 | .079 | .092 | .105 | .118 | .131 | .144 | .158 | .171 | .184 | .197 | .210 | .223 | .236 | .249 |
| .220 | | .055 | .069 | .083 | .096 | .110 | .124 | .138 | .151 | .165 | .179 | .193 | .206 | .220 | .234 | .248 | .261 |
| .230 | | .058 | .072 | .086 | .101 | .115 | .129 | .144 | .158 | .173 | .187 | .201 | .216 | .230 | .244 | .259 | .273 |
| .240 | | .060 | .075 | .090 | .105 | .120 | .135 | .150 | .165 | .180 | .195 | .210 | .225 | .240 | .255 | .270 | .285 |
| .250 | 1/4 | .063 | .078 | .094 | .109 | .125 | .141 | .156 | .172 | .188 | .203 | .219 | .234 | .250 | .266 | .281 | .297 |
| .260 | | .065 | .081 | .098 | .114 | .130 | .146 | .163 | .179 | .195 | .211 | .228 | .244 | .260 | .276 | .293 | .309 |
| .270 | | .068 | .084 | .101 | .118 | .135 | .152 | .169 | .186 | .203 | .219 | .236 | .253 | .270 | .287 | .304 | .321 |
| .280 | | .070 | .088 | .105 | .123 | .140 | .158 | .175 | .193 | .210 | .228 | .245 | .263 | .280 | .298 | .315 | .333 |
| .290 | | .073 | .091 | .109 | .127 | .145 | .163 | .181 | .199 | .218 | .236 | .254 | .272 | .290 | .308 | .326 | .344 |
| .300 | | .075 | .094 | .113 | .131 | .150 | .169 | .188 | .206 | .225 | .244 | .263 | .281 | .300 | .319 | .338 | .356 |
| .310 | | .078 | .097 | .116 | .136 | .155 | .174 | .194 | .213 | .233 | .252 | .271 | .291 | .310 | .329 | .349 | .368 |
| .3125 | 5/16 | .078 | .098 | .117 | .137 | .156 | .176 | .195 | .215 | .234 | .254 | .273 | .293 | .313 | .332 | .352 | .371 |
| .320 | | .080 | .100 | .120 | .140 | .160 | .180 | .200 | .220 | .240 | .260 | .280 | .300 | .320 | .340 | .360 | .380 |
| .330 | | .083 | .103 | .124 | .144 | .165 | .186 | .206 | .227 | .248 | .268 | .289 | .309 | .330 | .351 | .371 | .392 |
| .340 | | .085 | .106 | .128 | .149 | .170 | .191 | .213 | .234 | .255 | .276 | .298 | .319 | .340 | .361 | .383 | .404 |
| .350 | | .088 | .109 | .131 | .153 | .175 | .197 | .219 | .241 | .263 | .284 | .306 | .328 | .350 | .372 | .394 | .416 |
| .360 | | .090 | .113 | .135 | .158 | .180 | .203 | .225 | .248 | .270 | .293 | .315 | .338 | .360 | .383 | .405 | .428 |
| .370 | | .093 | .116 | .139 | .162 | .185 | .208 | .231 | .254 | .278 | .301 | .324 | .347 | .370 | .393 | .416 | .439 |
| .375 | 3/8 | .094 | .117 | .141 | .164 | .188 | .211 | .234 | .258 | .281 | .305 | .328 | .352 | .375 | .398 | .422 | .445 |
| .380 | | .095 | .119 | .143 | .166 | .190 | .214 | .238 | .261 | .285 | .309 | .333 | .356 | .380 | .404 | .428 | .451 |
| .390 | | .098 | .122 | .146 | .171 | .195 | .219 | .244 | .268 | .293 | .317 | .341 | .366 | .390 | .414 | .439 | .463 |
| .400 | | .100 | .125 | .150 | .175 | .200 | .225 | .250 | .275 | .300 | .325 | .350 | .375 | .400 | .425 | .450 | .475 |
| .410 | | .103 | .128 | .154 | .179 | .205 | .231 | .256 | .282 | .308 | .333 | .359 | .384 | .410 | .436 | .461 | .487 |
| .420 | | .105 | .131 | .158 | .184 | .210 | .236 | .263 | .289 | .315 | .341 | .368 | .394 | .420 | .446 | .473 | .499 |
| .430 | | .108 | .134 | .161 | .188 | .215 | .242 | .269 | .296 | .323 | .349 | .376 | .403 | .430 | .457 | .484 | .511 |
| .4375 | 7/16 | .109 | .137 | .164 | .191 | .219 | .246 | .273 | .301 | .328 | .355 | .383 | .410 | .438 | .465 | .492 | .520 |
| .440 | | .110 | .138 | .165 | .193 | .220 | .248 | .275 | .303 | .330 | .358 | .385 | .413 | .440 | .468 | .495 | .523 |
| .450 | | .113 | .141 | .169 | .197 | .225 | .253 | .281 | .309 | .338 | .366 | .394 | .422 | .450 | .478 | .506 | .534 |
| .460 | | .115 | .144 | .173 | .201 | .230 | .259 | .288 | .316 | .345 | .374 | .403 | .431 | .460 | .489 | .518 | .546 |
| .470 | | .118 | .147 | .176 | .206 | .235 | .264 | .294 | .323 | .353 | .382 | .411 | .441 | .470 | .499 | .529 | .558 |
| .480 | | .120 | .150 | .180 | .210 | .240 | .270 | .300 | .330 | .360 | .390 | .420 | .450 | .480 | .510 | .540 | .570 |
| .490 | | .123 | .153 | .184 | .214 | .245 | .276 | .306 | .337 | .368 | .398 | .429 | .459 | .490 | .521 | .551 | .582 |
| .500 | 1/2 | .125 | .156 | .188 | .219 | .250 | .281 | .313 | .344 | .375 | .406 | .438 | .469 | .500 | .531 | .563 | .594 |
| .510 | | .128 | .159 | .191 | .223 | .255 | .287 | .319 | .351 | .383 | .414 | .446 | .478 | .510 | .542 | .574 | .606 |
| .520 | | .130 | .163 | .195 | .228 | .260 | .293 | .325 | .358 | .390 | .423 | .455 | .488 | .520 | .553 | .585 | .618 |
| .530 | | .133 | .166 | .199 | .232 | .265 | .298 | .331 | .364 | .398 | .431 | .464 | .497 | .530 | .563 | .596 | .629 |
| .540 | | .135 | .169 | .203 | .236 | .270 | .304 | .338 | .371 | .405 | .439 | .473 | .506 | .540 | .574 | .608 | .641 |
| .550 | | .138 | .172 | .206 | .241 | .275 | .309 | .344 | .378 | .413 | .447 | .481 | .516 | .550 | .584 | .619 | .653 |
| .560 | | .140 | .175 | .210 | .245 | .280 | .315 | .350 | .385 | .420 | .455 | .490 | .525 | .560 | .595 | .630 | .665 |
| .5625 | 9/16 | .141 | .176 | .211 | .246 | .281 | .316 | .352 | .387 | .422 | .457 | .492 | .527 | .563 | .598 | .633 | .668 |
| .570 | | .143 | .178 | .214 | .249 | .285 | .321 | .356 | .392 | .428 | .463 | .499 | .534 | .570 | .606 | .641 | .677 |
| .580 | | .145 | .181 | .218 | .254 | .290 | .326 | .363 | .399 | .435 | .471 | .508 | .544 | .580 | .616 | .653 | .689 |
| .590 | | .148 | .184 | .221 | .258 | .295 | .332 | .369 | .406 | .443 | .479 | .516 | .553 | .590 | .627 | .664 | .701 |
| .600 | | .150 | .188 | .225 | .263 | .300 | .338 | .375 | .413 | .450 | .488 | .525 | .563 | .600 | .638 | .675 | .713 |
| .610 | | .153 | .191 | .229 | .267 | .305 | .343 | .381 | .419 | .458 | .496 | .534 | .572 | .610 | .648 | .686 | .724 |
| .620 | | .155 | .194 | .233 | .271 | .310 | .349 | .388 | .426 | .465 | .504 | .543 | .581 | .620 | .659 | .698 | .736 |
| .625 | 5/8 | .156 | .195 | .234 | .273 | .313 | .352 | .391 | .430 | .469 | .508 | .547 | .586 | .625 | .664 | .703 | .742 |
| .630 | | .158 | .197 | .236 | .276 | .315 | .354 | .394 | .433 | .473 | .512 | .551 | .591 | .630 | .669 | .709 | .748 |
| .640 | | .160 | .200 | .240 | .280 | .320 | .360 | .400 | .440 | .480 | .520 | .560 | .600 | .640 | .680 | .720 | .760 |
| .650 | | .163 | .203 | .244 | .284 | .325 | .366 | .406 | .447 | .488 | .528 | .569 | .609 | .650 | .691 | .731 | .772 |
| .660 | | .165 | .206 | .248 | .289 | .330 | .371 | .413 | .454 | .495 | .536 | .578 | .619 | .660 | .701 | .743 | .784 |
| .670 | | .168 | .209 | .251 | .293 | .335 | .377 | .419 | .461 | .503 | .544 | .586 | .628 | .670 | .712 | .754 | .796 |
| .680 | | .170 | .213 | .255 | .298 | .340 | .383 | .425 | .468 | .510 | .553 | .595 | .638 | .680 | .723 | .765 | .808 |
| .6875 | 11/16 | .172 | .215 | .258 | .301 | .344 | .387 | .430 | .473 | .516 | .559 | .602 | .645 | .688 | .730 | .773 | .816 |
| .690 | | .173 | .216 | .259 | .302 | .345 | .388 | .431 | .474 | .518 | .561 | .604 | .647 | .690 | .733 | .776 | .819 |
| .700 | | .175 | .219 | .263 | .306 | .350 | .394 | .438 | .481 | .525 | .569 | .613 | .656 | .700 | .744 | .788 | .831 |
| .710 | | .178 | .222 | .266 | .311 | .355 | .399 | .444 | .488 | .533 | .577 | .621 | .666 | .710 | .754 | .799 | .843 |
| .720 | | .180 | .225 | .270 | .315 | .360 | .405 | .450 | .495 | .540 | .585 | .630 | .675 | .720 | .765 | .810 | .855 |
| .730 | | .183 | .228 | .274 | .319 | .365 | .411 | .456 | .502 | .548 | .593 | .639 | .684 | .730 | .776 | .821 | .867 |
| .740 | | .185 | .231 | .278 | .324 | .370 | .416 | .463 | .509 | .555 | .601 | .648 | .694 | .740 | .786 | .833 | .879 |
| .750 | 3/4 | .188 | .234 | .281 | .328 | .375 | .422 | .469 | .516 | .563 | .609 | .656 | .703 | .750 | .797 | .844 | .891 |
| .8125 | 13/16 | .203 | .254 | .305 | .355 | .406 | .457 | .508 | .559 | .609 | .660 | .711 | .762 | .813 | .863 | .914 | .965 |
| .875 | 7/8 | .219 | .273 | .328 | .383 | .438 | .492 | .547 | .602 | .656 | .711 | .766 | .820 | .875 | .930 | .984 | 1.04 |
| .9375 | 15/16 | .234 | .293 | .352 | .410 | .469 | .527 | .586 | .645 | .703 | .762 | .820 | .879 | .938 | .996 | 1.05 | 1.11 |
| 1.000 | 1″ | .250 | .313 | .375 | .438 | .500 | .563 | .625 | .688 | .750 | .813 | .875 | .938 | 1.00 | 1.06 | 1.13 | 1.19 |

The reduction of areas for holes or thicknesses of plates not listed, may be found by addition or multiplication. Thus for a 2 3/4″ plate, multiply figure given for 11/16″ plate by 4, or add figure given for 3/4″ plate to twice that given for 1″ plate.

# DIMENSIONS AND WEIGHTS OF MACHINE BOLTS

## DIMENSIONS

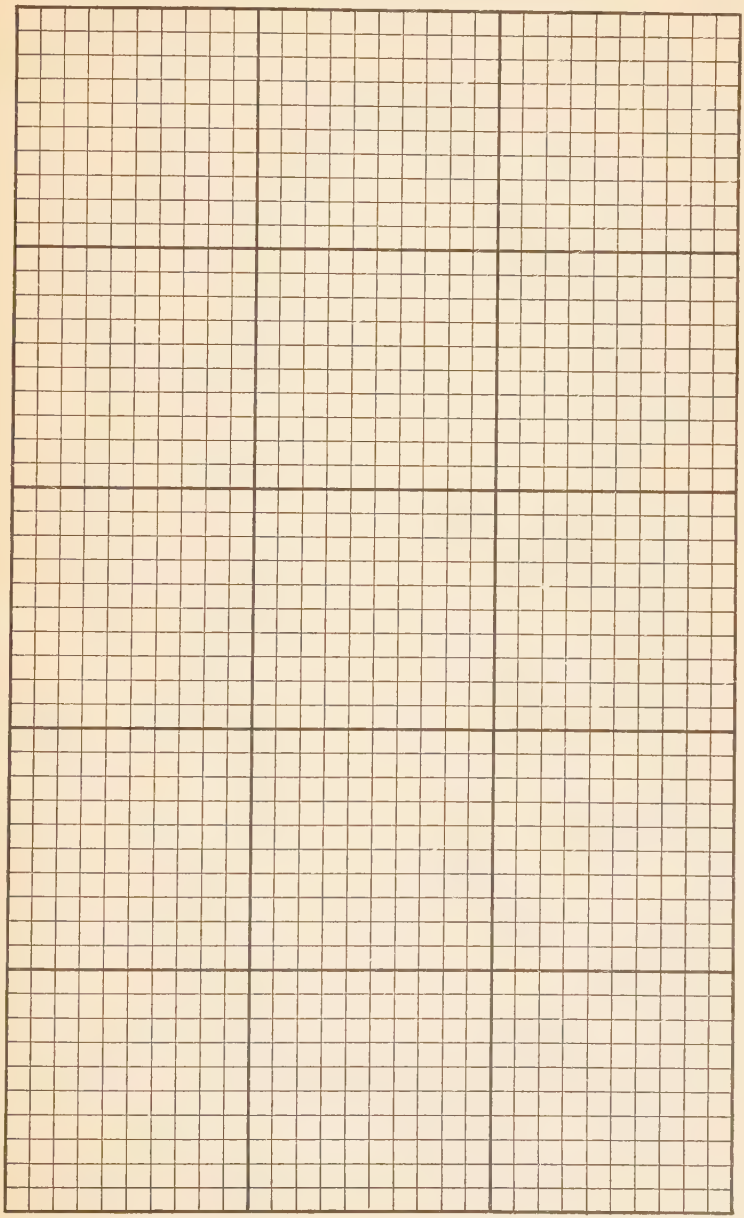



| Diam of Bolt | Bolt Head and Nut | | | | Bolt Head | Nut | Thread Details | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Square | | Hexagon | | | | Length of Bolt | | | | | | | No. of Thrds per Inch | Diam. at Root of Thread | Area at Root of Thread |
| | Diam. of Flats | Diam. of Corners | Diam. of Flats | Diam. of Corners | Height | Height | 1″ to 2″ | 2⅛ to 2½ | 2⅝ to 3″ | 3⅛ to 4″ | 4⅛ to 8″ | 8⅛ to 12″ | 12⅛ to 20″ | | | |
| D | F | C | F | C | H | N | Length of Thread T | | | | | | | | | |
| ¼ | ½ | 11/16 | ½ | 5/8 | ¼ | ¼ | ¾ | ¾ | ⅞ | ⅞ | 1 | 1 | 1 | 20 | .185 | .027 |
| ⅜ | 11/16 | 1 | 11/16 | 13/16 | ⅜ | ⅜ | ¾ | ¾ | ⅞ | ⅞ | 1 | 1 | 1 | 16 | .294 | .068 |
| ½ | ⅞ | 1 ¼ | ⅞ | 1 | 7/16 | ½ | 1 | 1 | 1 | 1¼ | 1¼ | 1½ | 1½ | 13 | .400 | .126 |
| ⅝ | 1 1/16 | 1 ½ | 1 1/16 | 1 ¼ | 9/16 | ⅝ | 1¼ | 1¼ | 1¼ | 1¼ | 1½ | 1¾ | 2 | 11 | .507 | .202 |
| ¾ | 1 ¼ | 1 13/16 | 1 ¼ | 1 7/16 | ⅝ | ¾ | 1½ | 1½ | 1½ | 1½ | 1¾ | 2 | 2 | 10 | .620 | .302 |
| ⅞ | 1 7/16 | 2 1/16 | 1 7/16 | 1 11/16 | ¾ | ⅞ | 1½ | 1¾ | 1¾ | 1¾ | 2 | 2¼ | 2¼ | 9 | .731 | .419 |
| 1 | 1 ⅝ | 2 5/16 | 1 ⅝ | 1 ⅞ | 13/16 | 1 | ... | 1¾ | 1¾ | 1¾ | 2¼ | 2½ | 2½ | 8 | .838 | .551 |
| 1⅛ | 1 13/16 | 2 9/16 | 1 13/16 | 2 ⅛ | 15/16 | 1⅛ | ... | ... | 2¼ | 2¼ | 2½ | 3 | 3 | 7 | .939 | .693 |
| 1¼ | 2 | 2 13/16 | 2 | 2 5/16 | 1 | 1¼ | ... | ... | ... | 2½ | 2¾ | 3 | 3 | 7 | 1.064 | .890 |
| 1⅜ | 2 3/16 | 3 ⅛ | 2 3/16 | 2 9/16 | 1 ⅛ | 1⅜ | ... | ... | ... | ... | 3¼ | 3½ | 3½ | 6 | 1.158 | 1.054 |
| 1½ | 2 ⅜ | 3 ⅜ | 2 ⅜ | 2 ¾ | 1 3/16 | 1½ | ... | ... | ... | ... | 3¾ | 4 | 4 | 6 | 1.283 | 1.294 |
| 1⅝ | 2 9/16 | 3 ⅝ | 2 9/16 | 3 | 1 5/16 | 1⅝ | ... | ... | ... | ... | 4 | 4¼ | 4¼ | 5½ | 1.389 | 1.515 |
| 1¾ | 2 ¾ | 3 ⅞ | 2 ¾ | 3 3/16 | 1 ⅜ | 1¾ | ... | ... | ... | ... | ... | 4½ | 4½ | 5 | 1.490 | 1.744 |
| 1⅞ | 215/16 | 4 3/16 | 215/16 | 3 7/16 | 1 ½ | 1⅞ | ... | ... | ... | ... | ... | 4¾ | 4¾ | 5 | 1.615 | 2.049 |
| 2 | 3 ⅛ | 4 7/16 | 3 ⅛ | 3 5/8 | 1 9/16 | 2 | ... | ... | ... | ... | ... | 5 | 5 | 4½ | 1 711 | 2.300 |
| 2¼ | 3 ½ | 415/16 | 3 ½ | 4 1/16 | 1 ¾ | 2¼ | ... | ... | ... | ... | ... | 5½ | 5½ | 4½ | 1 961 | 3.021 |
| 2½ | 3 7/8 | 5 ½ | 3 7/8 | 4 ½ | 115/16 | 2½ | ... | ... | ... | ... | ... | 6¼ | 6¼ | 4 | 2 175 | 3 716 |
| 2¾ | 4 ¼ | 6 | 4 ¼ | 415/16 | 2 1/8 | 2¾ | ... | ... | ... | ... | ... | 7 | 7 | 4 | 2.425 | 4 619 |
| 3 | 4 ⅝ | 6 9/16 | 4 ⅝ | 5 3/8 | 2 5/16 | 3 | ... | ... | ... | ... | ... | 7¾ | 7¾ | 3½ | 2 629 | 5.428 |
| 3¼ | 5 | 7 1/16 | 5 | 513/16 | 2 ½ | 3¼ | ... | ... | ... | ... | ... | 8½ | 8½ | 3½ | 2 879 | 6.509 |
| 3½ | 5 ⅜ | 7 ⅝ | 5 ⅜ | 6 ¼ | 211/16 | 3½ | ... | ... | ... | ... | ... | 9½ | 9½ | 3¼ | 3.100 | 7.549 |

## WEIGHTS PER HUNDRED WITH NUTS

| Length of Bolt | SQUARE HEADS AND NUTS | | | | | | | | | HEXAGON HEADS AND NUTS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Diameter of Bolt in Inches | | | | | | | | | Diameter of Bolt in Inches | | | | | |
| | ¼ | 5/16 | ⅜ | 7/16 | ½ | ⅝ | ¾ | ⅞ | 1″ | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1″ |
| 1 | 4 | 7 | 11 | 15 | 22 | 37 | 56 | ... | ... | 10 | 19 | 33 | 52 | ... | ... |
| 1¼ | 4 | 7 | 11 | 16 | 23 | 39 | 59 | ... | ... | 11 | 20 | 34 | 54 | ... | ... |
| 1½ | 5 | 8 | 12 | 17 | 24 | 41 | 62 | ... | ... | 12 | 22 | 36 | 57 | ... | ... |
| 1¾ | 5 | 8 | 13 | 18 | 26 | 43 | 64 | ... | ... | 12 | 23 | 38 | 60 | ... | ... |
| 2 | 5 | 9 | 14 | 19 | 27 | 45 | 67 | 101 | 144 | 13 | 24 | 40 | 63 | 93 | 132 |
| 2¼ | 6 | 9 | 15 | 20 | 28 | 47 | 71 | 104 | 150 | 14 | 26 | 43 | 66 | 97 | 137 |
| 2½ | 6 | 10 | 15 | 21 | 30 | 49 | 74 | 109 | 155 | 15 | 27 | 45 | 69 | 101 | 143 |
| 2¾ | 6 | 10 | 16 | 22 | 31 | 51 | 77 | 113 | 161 | 16 | 29 | 47 | 72 | 105 | 148 |
| 3 | 7 | 11 | 17 | 24 | 33 | 54 | 80 | 117 | 167 | 16 | 30 | 49 | 75 | 109 | 154 |
| 3½ | 7 | 12 | 18 | 25 | 35 | 58 | 86 | 126 | 178 | 18 | 33 | 54 | 82 | 118 | 165 |
| 4 | 8 | 13 | 20 | 28 | 38 | 62 | 92 | 134 | 189 | 19 | 35 | 58 | 88 | 126 | 176 |
| 4½ | 9 | 14 | 21 | 30 | 41 | 66 | 98 | 142 | 198 | 21 | 38 | 62 | 94 | 134 | 186 |
| 5 | 10 | 15 | 23 | 32 | 43 | 71 | 104 | 151 | 209 | 23 | 41 | 66 | 100 | 143 | 197 |
| 5½ | 10 | 16 | 25 | 34 | 46 | 75 | 111 | 159 | 220 | 24 | 44 | 71 | 106 | 151 | 208 |
| 6 | 11 | 17 | 26 | 36 | 49 | 79 | 117 | 168 | 232 | 26 | 46 | 75 | 112 | 160 | 219 |
| 6½ | .. | .. | 28 | 38 | 52 | 84 | 123 | 176 | 243 | 27 | 49 | 79 | 119 | 168 | 230 |
| 7 | .. | .. | 29 | 40 | 55 | 88 | 129 | 185 | 254 | 29 | 52 | 84 | 125 | 177 | 241 |
| 8 | .. | .. | 32 | 45 | 60 | 97 | 142 | 202 | 276 | 32 | 58 | 92 | 137 | 194 | 264 |
| 9 | .. | .. | 34 | 49 | 65 | 105 | 154 | 218 | 298 | 35 | 63 | 100 | 149 | 210 | 285 |
| 10 | .. | .. | .. | 53 | 71 | 114 | 167 | 235 | 320 | .. | 68 | 109 | 162 | 227 | 307 |
| 12 | .. | .. | .. | 61 | 82 | 131 | 192 | 269 | 364 | .. | 80 | 127 | 187 | 261 | 352 |
| 14 | .. | .. | .. | .. | 93 | 148 | 217 | 303 | 409 | .. | 91 | 144 | 212 | 295 | 396 |
| 1″ addition | 1.4 | 2 2 | 3 1 | 4.3 | 5 6 | 8.7 | 12 5 | 17.0 | 22.3 | 3 1 | 5.6 | 8.7 | 12.5 | 17.0 | 22.3 |

## NOTES and DIAGRAMS



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## NOTES and DIAGRAMS

# DECIMALS OF A FOOT

## FOR EACH 1/16 OF AN INCH FROM 1/16 TO 12 INCHES

| Fraction | Decimal | Fraction | Decimal | Fraction | Decimal | Fraction | Decimal |
|---|---|---|---|---|---|---|---|
| 1/16 | 0.0052 | 3 1/16 | 0.2552 | 6 1/16 | 0.5052 | 9 1/16 | 0.7552 |
| 1/8 | 0.0104 | 3 1/8 | 0.2604 | 6 1/8 | 0.5104 | 9 1/8 | 0.7604 |
| 3/16 | 0.0156 | 3 3/16 | 0.2656 | 6 3/16 | 0.5156 | 9 3/16 | 0.7656 |
| 1/4 | 0.0208 | 3 1/4 | 0.2708 | 6 1/4 | 0.5208 | 9 1/4 | 0.7708 |
| 5/16 | 0.0260 | 3 5/16 | 0.2760 | 6 5/16 | 0.5260 | 9 5/16 | 0.7760 |
| 3/8 | 0.0313 | 3 3/8 | 0.2813 | 6 3/8 | 0.5313 | 9 3/8 | 0.7813 |
| 7/16 | 0.0365 | 3 7/16 | 0.2865 | 6 7/16 | 0.5365 | 9 7/16 | 0.7865 |
| 1/2 | 0.0417 | 3 1/2 | 0.2917 | 6 1/2 | 0.5417 | 9 1/2 | 0.7917 |
| 9/16 | 0.0469 | 3 9/16 | 0.2969 | 6 9/16 | 0.5469 | 9 9/16 | 0.7969 |
| 5/8 | 0.0521 | 3 5/8 | 0.3021 | 6 5/8 | 0.5521 | 9 5/8 | 0.8021 |
| 11/16 | 0.0573 | 3 11/16 | 0.3073 | 6 11/16 | 0.5573 | 9 11/16 | 0.8073 |
| 3/4 | 0.0625 | 3 3/4 | 0.3125 | 6 3/4 | 0.5625 | 9 3/4 | 0.8125 |
| 13/16 | 0.0677 | 3 13/16 | 0.3177 | 6 13/16 | 0.5677 | 9 13/16 | 0.8177 |
| 7/8 | 0.0729 | 3 7/8 | 0.3229 | 6 7/8 | 0.5729 | 9 7/8 | 0.8229 |
| 15/16 | 0.0781 | 3 15/16 | 0.3281 | 6 15/16 | 0.5781 | 9 15/16 | 0.8281 |
| 1 | 0.0833 | 4 | 0.3333 | 7 | 0.5833 | 10 | 0.8333 |
| 1 1/16 | 0.0885 | 4 1/16 | 0.3385 | 7 1/16 | 0.5885 | 10 1/16 | 0.8385 |
| 1 1/8 | 0.0938 | 4 1/8 | 0.3438 | 7 1/8 | 0.5938 | 10 1/8 | 0.8438 |
| 1 3/16 | 0.0990 | 4 3/16 | 0.3490 | 7 3/16 | 0.5990 | 10 3/16 | 0.8490 |
| 1 1/4 | 0.1042 | 4 1/4 | 0.3542 | 7 1/4 | 0.6042 | 10 1/4 | 0.8542 |
| 1 5/16 | 0.1094 | 4 5/16 | 0.3594 | 7 5/16 | 0.6094 | 10 5/16 | 0.8594 |
| 1 3/8 | 0.1146 | 4 3/8 | 0.3646 | 7 3/8 | 0.6146 | 10 3/8 | 0.8646 |
| 1 7/16 | 0.1198 | 4 7/16 | 0.3698 | 7 7/16 | 0.6198 | 10 7/16 | 0.8698 |
| 1 1/2 | 0.1250 | 4 1/2 | 0.3750 | 7 1/2 | 0.6250 | 10 1/2 | 0.8750 |
| 1 9/16 | 0.1302 | 4 9/16 | 0.3802 | 7 9/16 | 0.6302 | 10 9/16 | 0.8802 |
| 1 5/8 | 0.1354 | 4 5/8 | 0.3854 | 7 5/8 | 0.6354 | 10 5/8 | 0.8854 |
| 1 11/16 | 0.1406 | 4 11/16 | 0.3906 | 7 11/16 | 0.6406 | 10 11/16 | 0.8906 |
| 1 3/4 | 0.1458 | 4 3/4 | 0.3958 | 7 3/4 | 0.6458 | 10 3/4 | 0.8958 |
| 1 13/16 | 0.1510 | 4 13/16 | 0.4010 | 7 13/16 | 0.6510 | 10 13/16 | 0.9010 |
| 1 7/8 | 0.1563 | 4 7/8 | 0.4063 | 7 7/8 | 0.6563 | 10 7/8 | 0.9063 |
| 1 15/16 | 0.1615 | 4 15/16 | 0.4115 | 7 15/16 | 0.6615 | 10 15/16 | 0.9115 |
| 2 | 0.1667 | 5 | 0.4167 | 8 | 0.6667 | 11 | 0.9167 |
| 2 1/16 | 0.1719 | 5 1/16 | 0.4219 | 8 1/16 | 0.6719 | 11 1/16 | 0.9219 |
| 2 1/8 | 0.1771 | 5 1/8 | 0.4271 | 8 1/8 | 0.6771 | 11 1/8 | 0.9271 |
| 2 3/16 | 0.1823 | 5 3/16 | 0.4323 | 8 3/16 | 0.6823 | 11 3/16 | 0.9323 |
| 2 1/4 | 0.1875 | 5 1/4 | 0.4375 | 8 1/4 | 0.6875 | 11 1/4 | 0.9375 |
| 2 5/16 | 0.1927 | 5 5/16 | 0.4427 | 8 5/16 | 0.6927 | 11 5/16 | 0.9427 |
| 2 3/8 | 0.1979 | 5 3/8 | 0.4479 | 8 3/8 | 0.6979 | 11 3/8 | 0.9479 |
| 2 7/16 | 0.2031 | 5 7/16 | 0.4531 | 8 7/16 | 0.7031 | 11 7/16 | 0.9531 |
| 2 1/2 | 0.2083 | 5 1/2 | 0.4583 | 8 1/2 | 0.7083 | 11 1/2 | 0.9583 |
| 2 9/16 | 0.2135 | 5 9/16 | 0.4635 | 8 9/16 | 0.7135 | 11 9/16 | 0.9635 |
| 2 5/8 | 0.2188 | 5 5/8 | 0.4688 | 8 5/8 | 0.7188 | 11 5/8 | 0.9688 |
| 2 11/16 | 0.2240 | 5 11/16 | 0.4740 | 8 11/16 | 0.7240 | 11 11/16 | 0.9740 |
| 2 3/4 | 0.2292 | 5 3/4 | 0.4792 | 8 3/4 | 0.7292 | 11 3/4 | 0.9792 |
| 2 13/16 | 0.2344 | 5 13/16 | 0.4844 | 8 13/16 | 0.7344 | 11 13/16 | 0.9844 |
| 2 7/8 | 0.2396 | 5 7/8 | 0.4896 | 8 7/8 | 0.7396 | 11 7/8 | 0.9896 |
| 2 15/16 | 0.2448 | 5 15/16 | 0.4948 | 8 15/16 | 0.7448 | 11 15/16 | 0.9948 |
| 3 | 0.2500 | 6 | 0.5000 | 9 | 0.7500 | 12 | 1.0000 |

# DECIMALS OF AN INCH

## FOR EACH 1/64TH.

| Fractions | Decimals | Fractions | Decimals |
|---|---|---|---|
| 1/64 | 0.015625 | 33/64 | 0.515625 |
| 1/32 | 0.03125 | 17/32 | 0.53125 |
| 3/64 | 0.046875 | 35/64 | 0.546875 |
| 1/16 | 0.0625 | 9/16 | 0.5625 |
| 5/64 | 0.078125 | 37/64 | 0.578125 |
| 3/32 | 0.09375 | 19/32 | 0.59375 |
| 7/64 | 0.109375 | 39/64 | 0.609375 |
| 1/8 | 0.125 | 5/8 | 0.625 |
| 9/64 | 0.140625 | 41/64 | 0.640625 |
| 5/32 | 0.15625 | 21/32 | 0.65625 |
| 11/64 | 0.171875 | 43/64 | 0.671875 |
| 3/16 | 0.1875 | 11/16 | 0.6875 |
| 13/64 | 0.203125 | 45/64 | 0.703125 |
| 7/32 | 0.21875 | 23/32 | 0.71875 |
| 15/64 | 0.234375 | 47/64 | 0.734375 |
| 1/4 | 0.250 | 3/4 | 0.750 |
| 17/64 | 0.265625 | 49/64 | 0.765625 |
| 9/32 | 0.28125 | 25/32 | 0.78125 |
| 19/64 | 0.296875 | 51/64 | 0.796875 |
| 5/16 | 0.3125 | 13/16 | 0.8125 |
| 21/64 | 0.328125 | 53/64 | 0.828125 |
| 11/32 | 0.34375 | 27/32 | 0.84375 |
| 23/64 | 0.359375 | 55/64 | 0.859375 |
| 3/8 | 0.375 | 7/8 | 0.875 |
| 25/64 | 0.390625 | 57/64 | 0.890625 |
| 13/32 | 0.40625 | 29/32 | 0.90625 |
| 27/64 | 0.421875 | 59/64 | 0.921875 |
| 7/16 | 0.4375 | 15/16 | 0.9375 |
| 29/64 | 0.453125 | 61/64 | 0.953125 |
| 15/32 | 0.46875 | 31/32 | 0.96875 |
| 31/64 | 0.484375 | 63/64 | 0.984375 |
| 1/2 | 0.500 | 1″ | 1.000 |

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